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Albuquerque District

RIO GRANDE FLOODWAY
Truth or Consequences Unit, NM

CUCHILLO NEGRO DAM

FOUNDATION REPORT, Volume III
Appendix E, Appendix F, and Appendix G

CONSTRUCTION FOUNDATION REPORTS
ER 1110-1-1801

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Cuchillo Negro Dam was completed in July 1991. The project, which is a dry, flood control only reservoir, consists of a main dam and an auxiliary spillway. The dam consists of a 750-foot-long earth embankment section and a 590-foot-long roller compacted concrete (RCC) section. The crest of the earth embankment section is 21 feet wide, and it is 25 feet wide for the RCC section. The dam has an overflow spillway and rises 134 feet above the channel bottom. The auxiliary spillway is an RCC lined spillway with a conventional concrete Ogee. It is 680 feet wide and extends from a point 260 feet from the right abutment of the RCC dam in a southeasterly direction. Numerous unanticipated geologic conditions were encountered during excavation of the foundation trench. This led to design changes and modifications to the contract.

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Seismic Analysis Report

SEISMIC ANALYSIS REPORT
FOR
CUCHILLO NEGRO DAM SITE
SIERRA COUNTY, NEW MEXICO

SECTION 1 - INTRODUCTION

1.1 GENERAL

a. Authority. The authority for the preparation of this Seismic Analysis Report is contained in ER 1110-2-1806, dated 16 May 1983. Subject: Earthquake Design and Analysis for Corps of Engineers Dams.

b. Purpose and Scope. This report presents the results of seismic analysis studies for Cuchillo Negro Dam Site. These studies have been conducted by Tierra Engineering Consultants, Inc. under contract with the Albuquerque District, U.S. Army Corps of Engineers. A detailed geological and seismological review of all existing data was required to define the maximum earthquake. The design earthquake forms the basis for estimating ground motions felt at the site.

1.2 DESCRIPTION OF PROJECT

a. Location. The Cuchillo Negro dam site is located in the southeast quarter, section 35, T12S, R5W, Cuchillo 7.5 minute topographic quadrangle, Sierra County, New Mexico, approximately 6.3 miles northwest of Truth or Consequences, (T or C), (Figure 1). The dam site may be reached via I-25 north from T or C to state highway 52, west on state highway 52 to approximately 0.3 miles east of the center of the town of Cuchillo, then southeast via dirt roads in Cuchillo Negro Creek 2.5 miles to the dam site.

b. General Project Description. The Rio Grande Floodway was authorized by Section 203 of the Flood Control Act of 1948. Cuchillo Dam would be located on Cuchillo Negro Creek at the Cuchillo site and would retain the 100 year flood at this site. The dam would form a reservoir about 2.3 miles long with a capacity of 13,500 acre-feet at the spillway crest. The project consists of a roller compacted concrete section rising 119 feet above the streambed. The streambed alluvium at the damsite will be excavated to suitable rock (approximately 36 feet) and the ungated outlet works located approximately in the center of the dam. An earthfill embankment would extend from the RCC section to high ground on the left abutment. An RCC spillway would be located on a small unnamed tributary 800 feet south of the dam.

c. Dam. The earthfill embankment would be a zoned section having a 12-foot crest and 1V to 3H sideslopes. Seepage control would be provided by a semi-impervious core and inspection trench. Slope protection would be provided by 18-inches and 12-inches of dumped rock upstream and downstream, respectively.

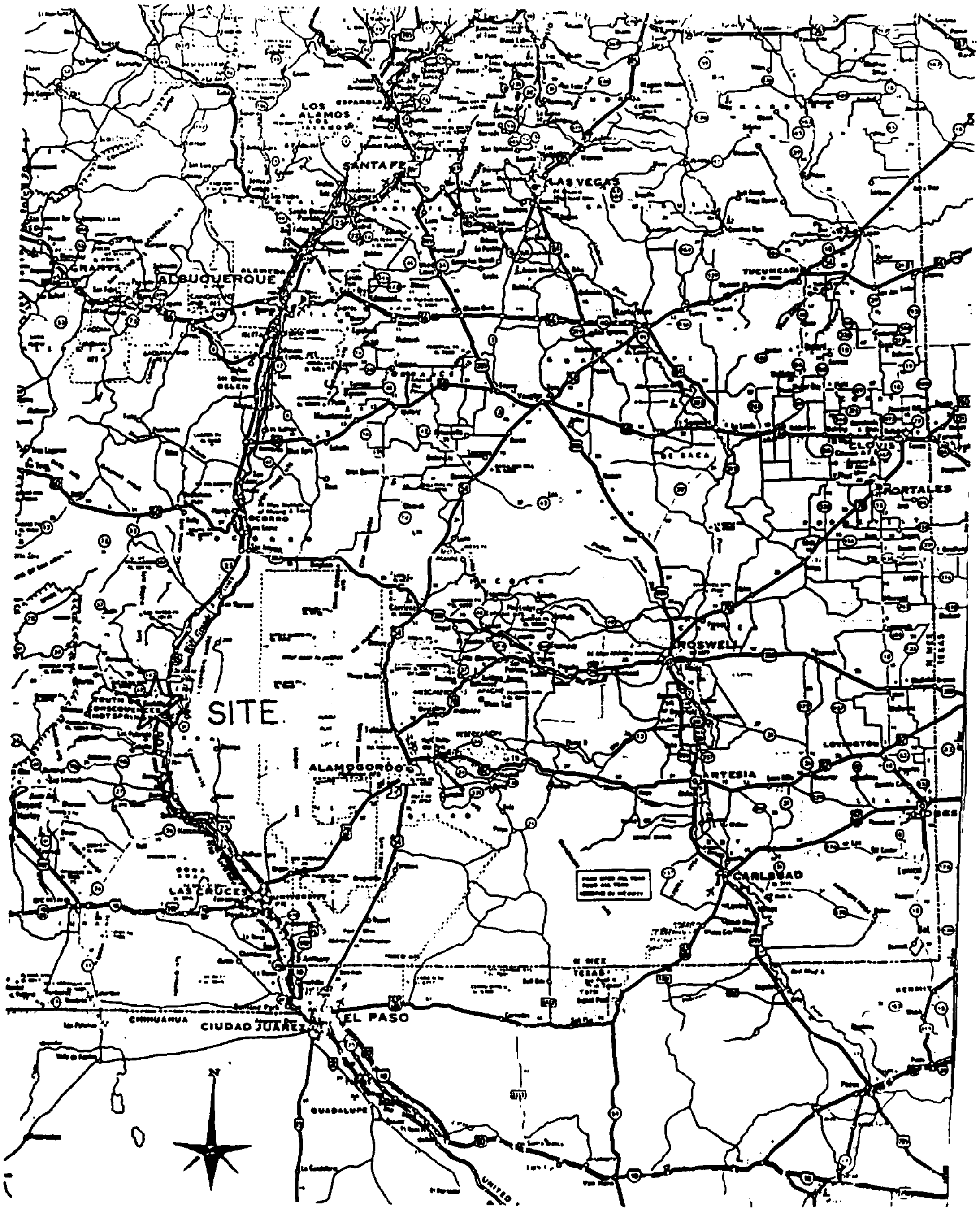


Figure 1
Map of New Mexico showing location of
Cuchillo Negro Dam Site

d. Outlet Works. The outlet works would consist of an intake structure with trashracks, an outlet conduit 111 feet long and a terminal energy dissipator. The reinforced concrete intake tower would be approximately 73 feet high.

e. Spillway. An RCC stepped spillway would be located on a small tributary 800 feet south of the dam on Cuchillo Creek. The structure would have a crest length of 1100 feet and a height above streambed of 71 feet. The upstream face would be vertical and the downstream slope would be comprised of steps 12 feet wide by 10 feet high. The ogee section, over the entire crest length, would be constructed of conventional concrete, two feet thick, as would the vertical faces of the stepped spillway. A small ungated outlet works with intake tower would be constructed for the spillway structure to pass low flows from the tributary drainage. The intake tower would be approximately 50 feet high with trashracks. An 800-foot wide overflow section would be excavated between the two drainage tributaries to provide access for the flood flows to reach the spillway structure.

f. Previous Studies. Studies of the Site Geology, construction materials and embankment design have been conducted by the Corp of Engineers. The results of these studies are included in the Formulation Plan for Cuchillo Negro dated 1986.

SECTION 2 - GEOLOGY

2.1 REGIONAL SETTING

The dam site is located along the west side of the Rio Grande rift in the Basin and Range physiographic province at the north end of the Mud Spring Mountains. The Mud Spring Mountains form the approximate boundary between the Engle basin to the north-northeast and the Palomas basin to the south-southwest (Figure 2). The Mud Spring Mountains, approximately 5.5 miles long and 1.5 miles wide, are a low, narrow range with a maximum relief of 1,400 feet above the floor of Cuchillo Negro Creek. Cuchillo Negro Creek is an ephemeral stream whose tributaries in the dam site area generally exhibit trellis drainage patterns. In the dam site area the valley of Cuchillo Negro Creek ranges in width from 2,000 feet to approximately 50 to 75 feet at the dam site.

The climate of the area is arid hot desert (Mueler, 1986). The vegetation consists of short desert grasses and creosote bush with minor mesquite trees and yucca. Mueller (1986) reports a mean annual temperature for T or C of 59.8 F with temperature extremes of 106 F July 14, 1979 and -5 F January 11, 1962. The average annual precipitation for the T or C area is 8.77 inches with extremes of 14.64 inches in 1972 and 3.36 inches in 1956. The record rainfall of 3.16 inches for a 24 hour period occurred on September 14, 1976.

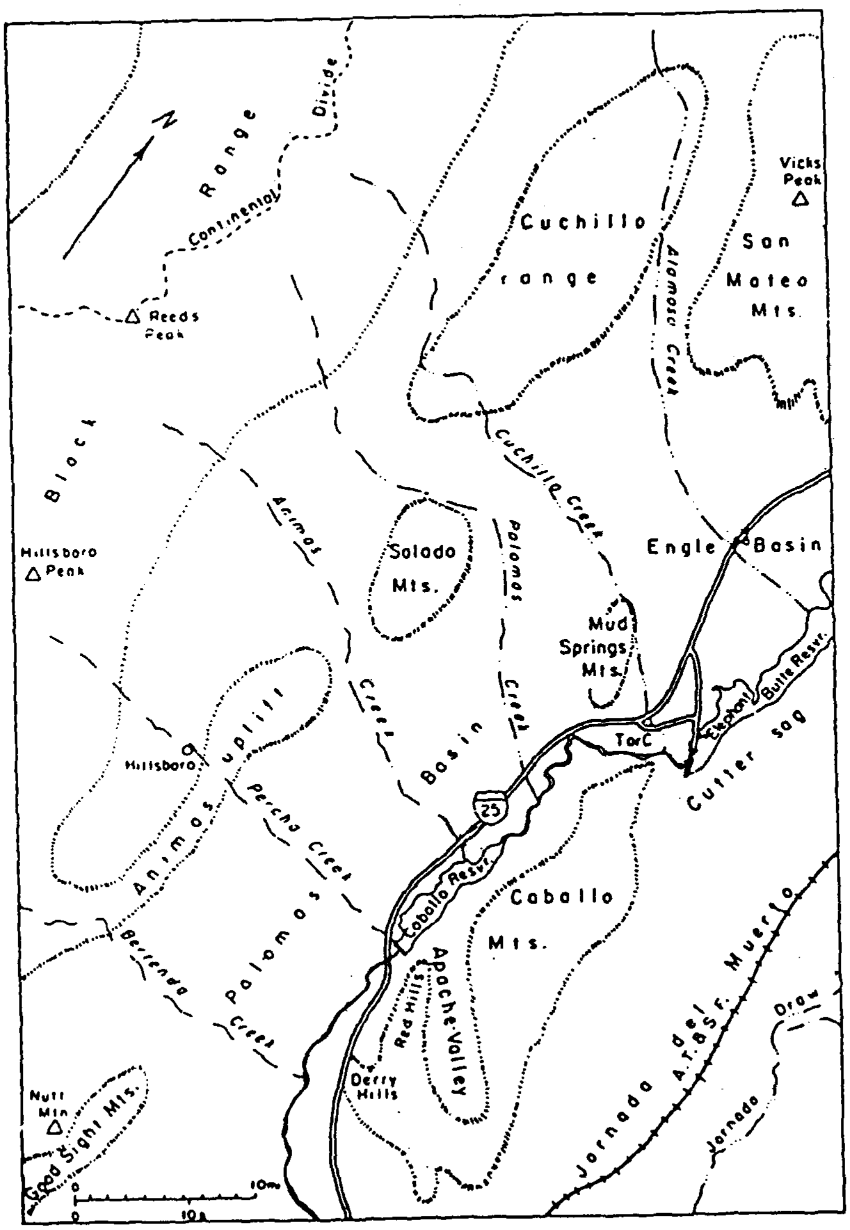


Figure 2
Physiographic map showing location of the Mud Spring Mountains and T or C: Hawley and Seager, 1978

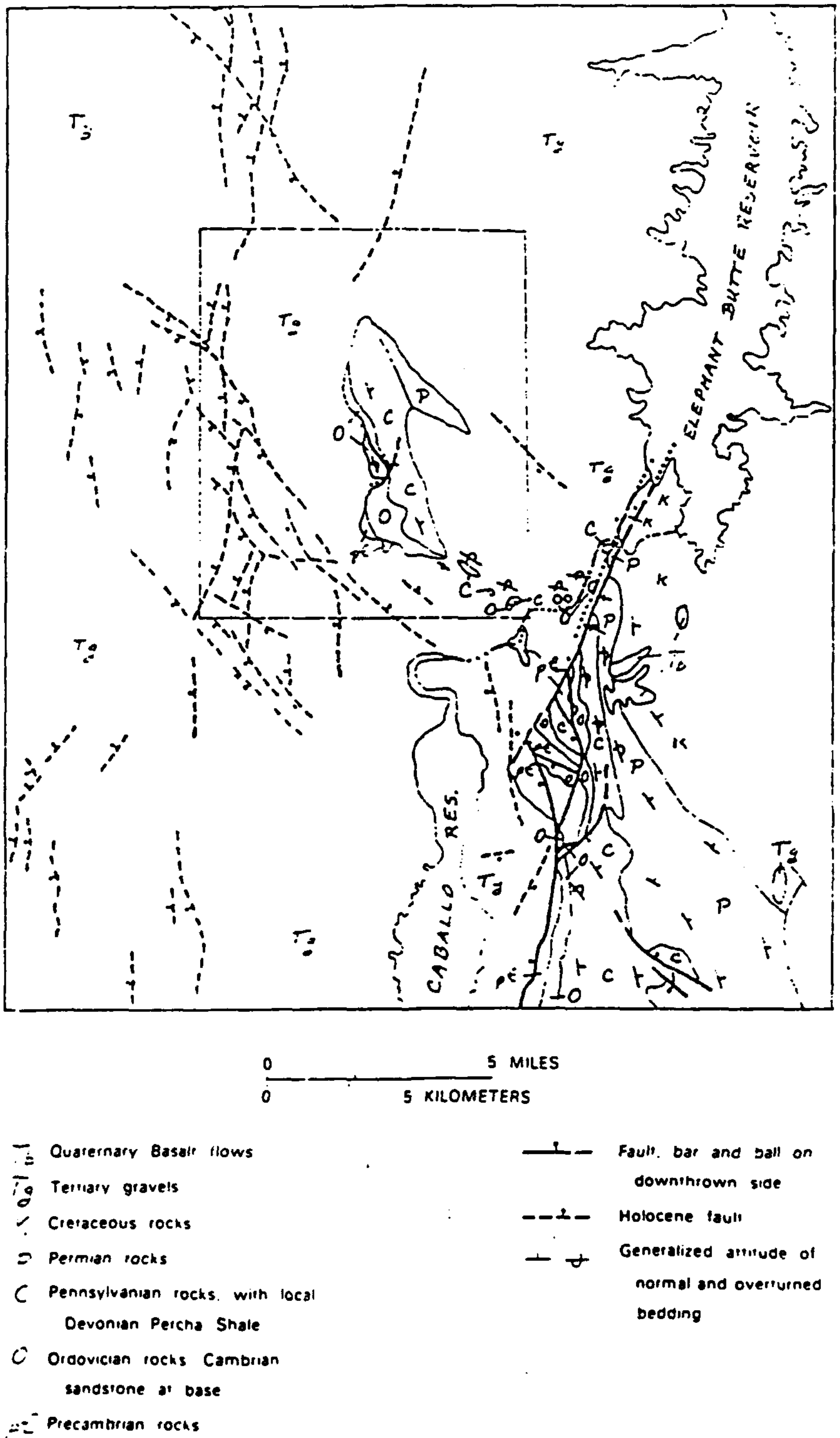


Figure 3
Reconnaissance geologic map of the Cuchillo Quadrangle and T or C area: Maxwell and Oakman, 1986

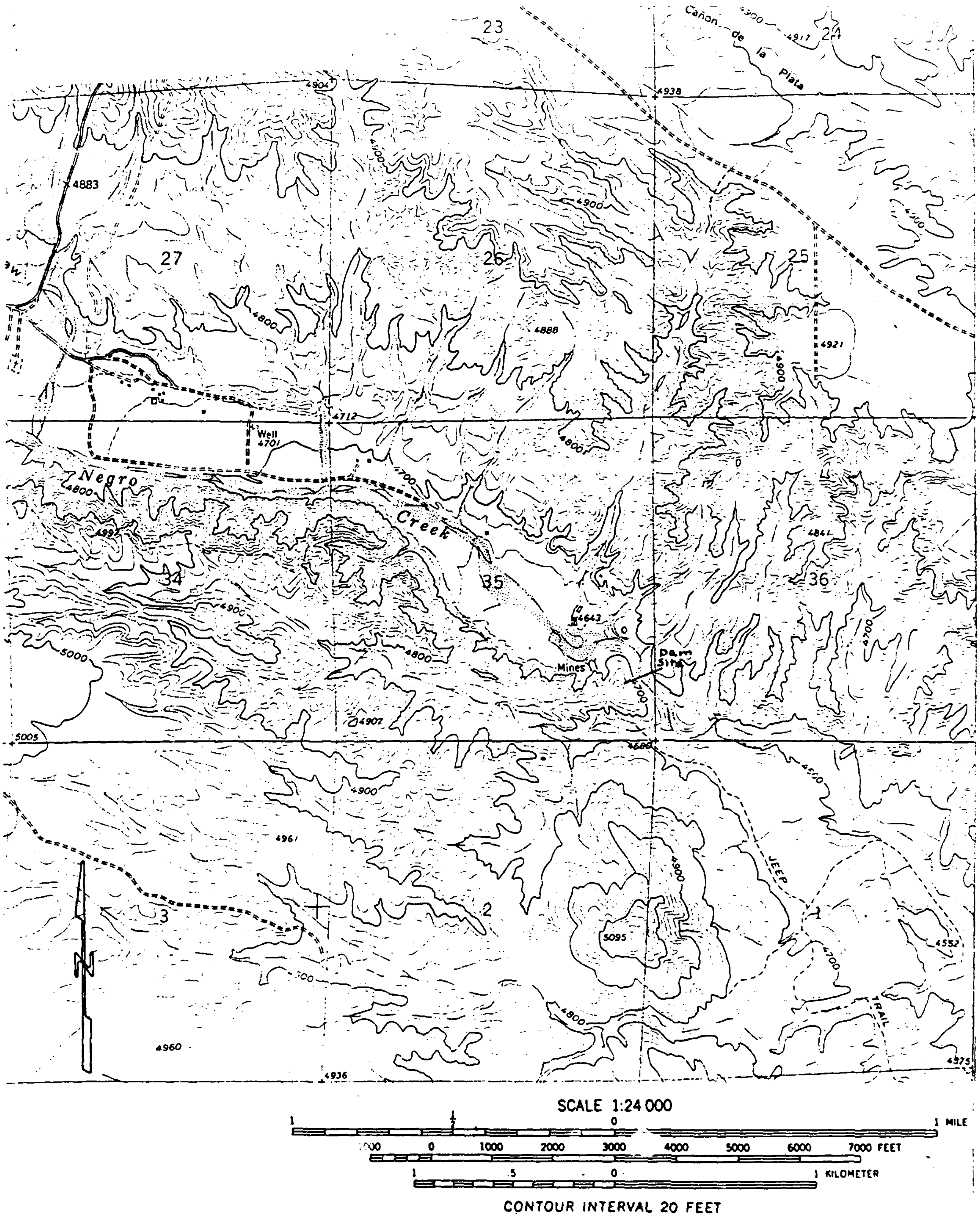


Figure 4
Topographic map: Cuchillo 7.5 min. Quad., USGS

2.2 Local Geology

The Mud Springs Mountains, a northeast dipping homoclinal structure is comprised of Precambrian through Pennsylvanian rocks. This northwest-southwest trending range abuts the Caballo uplift to the southeast along the northeast-southwest trending Hot Springs fault. This mountain range may be considered an intra-rift horst block. The block faulting appears to have commenced during the Laramide, ± 70 mybp and appears to have been reactivated less than 10 mybp during Pliocene time as evidenced by deformation of Miocene sediments exposed in Cuchillo Negro Creek northwest of the north end of the Mud Spring Mountains. Figure 3 (Maxwell & Oakman, 1986) is a reconnaissance geologic map of the T or C area showing the regional geology. The far north end of the Mud Spring Mountains is just now being exposed by erosion. The thick sections of Miocene and Pliocene sediments that unconformably overly the Paleozoic section on the flanks of the Mud Springs Mountains were derived primarily from ancestral stream systems of what are now Cuchillo and Palomas creeks, with headwaters in the Black and Cuchillo ranges.

Figure 4 is a topographic map of the dam site area showing the location of the dam (Cuchillo Quad. 7.5 min. topo map USGS).

Figure 5 is a detailed geologic map of the dam site area (Maxwell and Oakman, 1986). Table 1, compiled from Maxwell and Oakman (1986) describes the lithologic units in the Cuchillo Negro dam site area shown on the geologic map. For a more detailed lithologic description the reader is referred to Maxwell and Oakman (1986).

TABLE 1

Description of Map Units

Qal	Alluvium (Holocene) - unconsolidated sand, silt, and gravel. Includes some alluvial fan deposits and terrace gravels.
	Terrace Gravels (Pleistocene) - four levels of terraces have been developed on the slopes of the incised valleys.
Qt4	Youngest terrace, 20 - 30 ft above Cuchillo Negro Creek, silt, sand, gravel.
Qt3	Third terrace, 50 - 70 ft above Cuchillo Negro Creek, soil, sand, gravel, minor caliche.
Qt2	Second terrace, 90 - 120 ft above creek, soil, sand, gravel, poorly developed caliche.
Qt1	Oldest terrace, 150 - 200 ft above creek, 60 - 80 ft below Cuchillo pediment surface, caliche 2 - 4 ft thick, little soil or detritus.
Qtp	Pediment deposits (Pliocene) - silt, sand, gravel well-developed soil, developed on Palomas Gravels. Extensive Cuchillo surface very well developed on top of pediment surface.
Tpg	Palomas Gravel (Pliocene) - light-to-medium-gray lenticular gravel and sandy gravel interbedded with light-pink, tan and greenish-gray silt, sand, and conglomeratic sandstone, white sand, and moderate orange-red to brick-red and moderate green mudstone. Several altered ash beds near top of unit.
Tsf	Santa Fe Group (Miocene) - reddish-gray, pale-brown, and tan, slightly indurated conglomeratic and sandy mudstone, calcareous mudstone, and sandstone, in part tuffaceous.

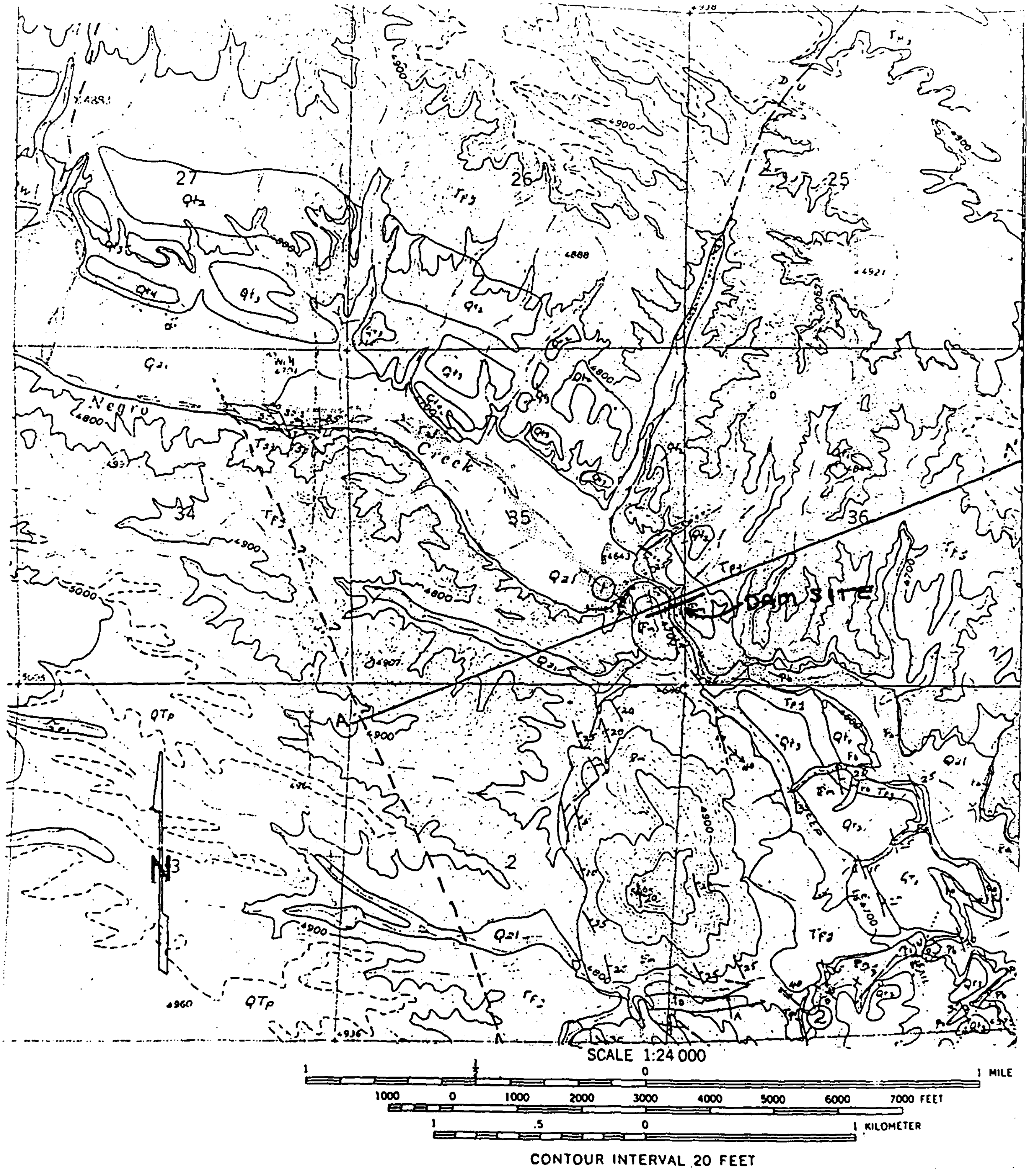


Figure 5
Detailed geologic map of the dam site area. Modified from Maxwell and Oakman, 1986

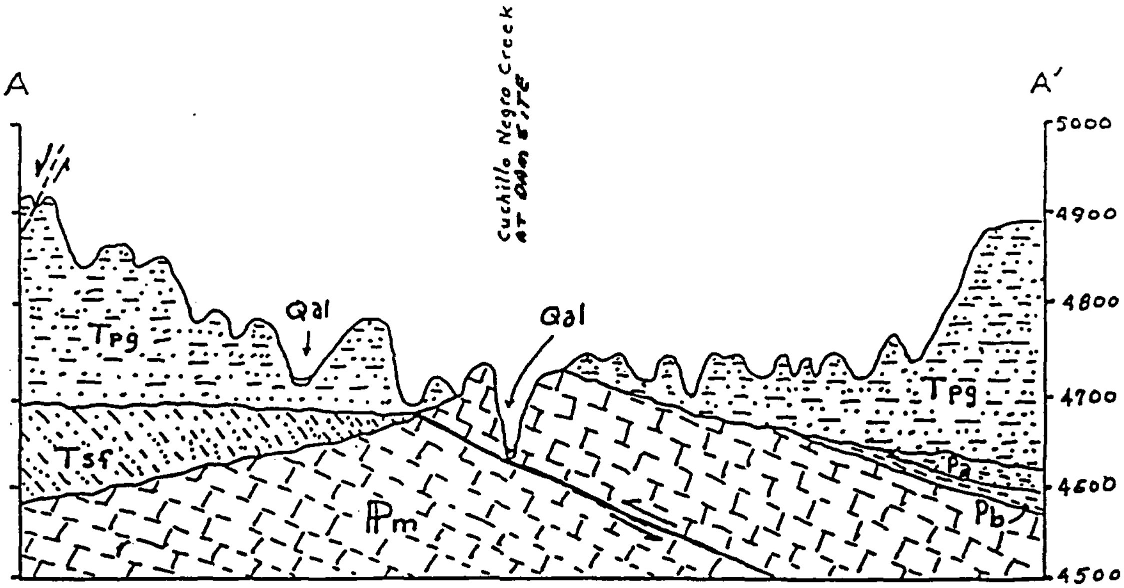


Figure 6
Geologic Cross Section Looking Northwest, Cuchillo Negro Dam Site

Horizontal scale: 1:24000
Vertical scale: 1:2400
Vertical exageration x10

Legend: Map and Cross Section

- CONTACT—Dashed where approximately located; dotted where concealed
- FAULT—Showing dip where measured. Dashed where approximately located or inferred; dotted where concealed. U, upthrown side; D, downthrown side. Arrows indicate relative lateral motion
- ANTICLINE
- SYNCLINE
- MONOCLINE—Showing trace and plunge of axis. A, anticlinal bend; S, synclinal bend
- DRAG FOLD—Showing plunge
- STIKE AND DIP OF BEDS—Dot marks point of observation
- STRIKE OF VERTICAL BEDS
- STRIKE AND DIP OF OVERTURNED BEDS
- JASPEROID VEINS
- VEIN—Dashed where inferred
- MANGANESE MINERALIZATION
- FOSSIL LOCALITY
- QUARRY
- MINE OR PROSPECT
- SAMPLE LOCALITY

Pa Abo Formation (Lower Permian) - dark-red shale and sandstone with minor lenses of orange-red arkosic sandstone and conglomerate and purplish-gray nodular calcareous mudstone.

Pb Bursum Formation (Lower Permian) - moderate red, green, and purplish-gray shale and calcareous shale, minor red sandstone and gray limestone.

Pm Madera Formation (Pennsylvanian) - upper part light-to-dark-gray thin-bedded shale, minor greenish-gray and reddish-gray siltstone and shale. Middle part thick to massive cherty limestone with thin gray shale interbeds. Lower part gray, thin-bedded, cherty limestone and calcarenite, light-gray and green, thin to thick shale beds.

The major faulting in the area commenced in the Laramide and was reactivated in the Pliocene. The throw on the range bounding faults of the Mud Springs Mountains can not be calculated as these faults are not exposed. However, the throw may be estimated in the thousands of feet. Faulting was again active during the Pliocene and remained active during the Pleistocene as evidenced by the faulted Pleistocene river terrace gravel deposits in sections 21 and 28, T12S, R5W, just west of the town of Cuchillo. The writer can not say with any degree of certainty that these faults are not active. There is, however some evidence for faulting in Recent (Holocene) geologic time, 10,000 years b.p. or younger west and north of the Mud Springs Mountains (Figure 3). The vertical displacement on these Pleistocene/Holocene faults appears to be no more than a few feet. The fault traces are indistinct and can only be inferred or approximately located. It is the writer's opinion that the only faults in the immediate area of the Mud Springs Mountains with the potential to be capable faults are the major range bounding faults which are not exposed and the Hot Springs fault which trends northeast-southwest just east of T or C. The Hot Springs fault does exhibit Pleistocene movement. There is some Pleistocene to Recent geologic faulting north and west of the mountains that tends to support the possibility that these range bounding faults are capable.

SECTION 3 - SEISMOLOGY

3.1 INTRODUCTION

The Cuchillo Negro dam site is in the Rio Grande rift in the New Mexico Basin and Range physiographic province. The Rio Grande rift is the most seismically active area in New Mexico. Most of the seismic activity occurs between Socorro and Albuquerque, (approximately 200 earthquakes have been recorded through 1980) and is attributed to the injection of magma at depth in the central part of the rift (Sanford, Olsen and Jaksha, 1980). The dam site is about 65 miles south southwest from Socorro and is outside the zone of high seismic activity.

3.2 EARTHQUAKE DATA

There have been several studies to estimate the size of an earthquake a given area can expect. Sanford, et. al., (1972) gave general projections of the magnitude of earthquakes within the Rio Grande Rift based on both historical records and on more recent instrument-detected earthquakes. Krinitzsky and Chang (1975) discuss the effects of distance on the intensity felt, for an earthquake of a give magnitude. They also discuss the ground motion produced by a given intensity shock. Bonilla and Buchanan (1970) give correlations between earthquake magnitude and the length of surface rupture. Bonilla (1970) gives corelations between earthquake magnitude and maximum displacement on a main fault. These references have all been used in developing the discussion which follows.

The nearest recorded earthquake to the dam site had its epicenter 28 miles south, southwest. That earthquake occurred January 31, 1939 and had a maximum intensity of IV (modified Mercalli) (Stover, Reagor and Algermissen, 1983).

Table 2 is a listing of the earthquakes reported felt in New Mexico prior to 1962 with maximum intensities (modified Mercalli) of V or greater (modified from Sanford, Olsen and Jaksha, 1981). The magnitudes for the earthquakes have been calculated using the proceedure set forth in Krinitzski and Chang (1975).

Figure 7, modified from Sanford, Olsen and Jaksha (1981) is a map of New Mexico depicting the data from Table 2. The large circle on the map centered at the dam site encompasses all the earthquakes within an 85 mile radius of the dam site, a total of 217 separate events through 1980 (Stover, Reagor and Algermissen, 1983). The maximum intensity of the epicenters inside the circle was an VIII (mM), 8 miles southwest of Socorro in 1906.

Figure 8, from Sanford, Olsen and Jaksha (1981), depicts the seismic events in New Mexico from 1962 through 1977. For a complete listing of all the recorded seismic events that occurred within New Mexico the reader is referred to Stover, Reagor and Algermissen (1983).

The May 3, 1887 earthquake with its epicenter located in the area of Batepito-Bavispe, Sonora, Mexico (Figure 9) represents a far field earthquake which may be felt at this site. The maximum intensity of this earthquake at the epicenter was XII (DuBois and Smith, 1980). The destruction of the towns was total. DuBois and Smith (1980) show a fault scarp 30 miles long resulting from this earthquake (Figure 9). The throw on the fault was up to 20 feet and the movement was right lateral. DuBois and Smith (1980) report there is additional geologic evidence (faults) indicating pre-1887 and post-1887 seismic activity in the region. Therefore the area is seismically active and the fault capable.

The effect of this earthquake in New Mexico was substantial. DuBois and Smith (1980) have calculated the maximum local intensity from recorded accounts of the shock in New Mexico.

Table 3 lists the maximum intensity (modified Mercalli) for various locals in New Mexico

TABLE 3

Location	Maximum Instensity (mM)
Albuquerque, Bernalillo Co, NM	VI
Cubero Mesa, Cibola Co., NM	VII
Deming, Luna Co., NM	VIII
Lake Valley, San Juan Co., NM	V
Las Cruces, Dona Ana Co., NM	VII
Las Vegas, San Miguel Co., NM	II
Mesilla, Dona Ana Co., NM	VI
Organ, Dona Ana Co., NM	V
Rio Grande Valley, NM	IV
Sabinal, Socorro Co., NM	IX
San Marcel, Socorro Co., NM	VII
Santa Fe, Santa Fe Co., NM	III
Silver City, Grant Co., NM	VIII

3.3 DESIGN EARTHQUAKE DEFINITIONS

Design earthquakes define the ground motion at the site of the structure.

a. Maximum Earthquake. The maximum earthquake is defined as the severest earthquake that is believed to be possible at the site on the basis of geological and seismological evidence.

b. Capable Fault. A capable fault is a fault that is considered to have the potential for generating an earthquake.

3.4 MAXIMUM EARTHQUAKE

The maximum earthquake for the site should be the earthquake that has the potential to produce the maximum ground motion. The three likely candidates for the Cuchillo Negro area are:

a. An earthquake along the western front of the Sierra Madres similar to the San Bernardina Valley, Sonora Mexico earthquake of 1887. This fault runs from near Douglas Arizona, south, a reported destance in excess of 50 kilometers. The fault is approximately 180 miles from Cuchillo Negro at its nearest location.

An earthquake originating along the Sierra Madres has the potential of producing on intensity of VII to VIII (mM) at Cuchillo Negro. Du Bois and Smith (1980) indicate geologic evidence of pre 1887 and post 1887 seismic activity in the region therefore the area is seismically active and the fault is capable.

b. An earthquake originating in the Socorro, area approximately 50 miles north.

An earthquake originating near Socorro, New Mexico has the potential of producing an intensity of VII to VIII (mM) at Cuchillo Negro.

c. A local earthquake originating in the near vicinity of the dam site. (See Figure 10).

The earthquake potential from a local source was evaluated based on the previous discussion of the range bounding faults in the vicinity of the Mud Springs Mountains. While the faults are not exposed and therefore cannot be evaluated there is some evidence for faulting in recent (Holocene) geologic time, 10,000 years b.p. or younger west and north of Mud Springs Mountains. This would indicate that the faults are capable.

A review of the fault trace presented as Figure 10 would indicate a potential fault length of about 20 to 25 miles.

A local fault is therefore capable and may have a fault length of 40 km. Assuming that 1/2 of the fault length could rupture and using the emperical relationships developed by Bonilla and Cuchanan (1970) and Bonilla (1970), which provide correlations between earthquake magnitude and the length of surface rupture a maximum earthquake of magnitude 6.0 is indicated. This relates to an intensity of VIII (mM).

3.5 GROUND MOTION

Krinitzsky and Chang (1975) present several graphs showing ground motions that can be expected, due to wave propogation, from earthquakes of different intensities and include the effects of distance from the source. Of particular note is the finding that peak velocities experienced at a site from near field and far field earthquakes are only slightly different. Peak accelerations however are substantially reduced from distant earthquakes.

Based on the above discussion, the earthquake likely to produce the maximum ground motion at the Cuchillo Negro site is the local event. A local earthquake having a magnitude of 6.0 was therefore selected as the design earthquake which is also the maximum earthquake.

An earthquake of magnitude 6.0, in the near field, has a 75% likelihood of a peak ground velocity of about 1.2 ft/sec or less; a peak acceleration of about 12.5 ft/sec (0.4 G's) or less, and a peak displacement of 0.52 feet or less. It should be noted that these figures refer to ground motions due to a shock and not to displacement along a surface rupture.

The intensity and duration of ground shaking are important characteristics of earthquake ground motion. The intensity of ground shaking relates to the magnitude of stress and strain induced in the soil; its duration affects the number of stress cycles to which the soil is subject. The duration is a function of the energy released, wave frequency, amplitude and distance from the epicenter. One measure of duration, called "bracketed duration", is the time during which the acceleration level equals or exceeds 0.05 G's. This threshold is used because of its approximate correspondence with the strong phase of ground shaking. Relations developed by Bolt (1973) indicate that for accelerations greater than 0.05 G's and a frequency greater than 1 hertz, the expected duration for the maximum earthquek would be about 11 seconds.

Table 2
Earthquakes reported felt in New Mexico prior to 1962 with maximum intensities (modified Mercalli) of V or greater. Modified from Sanford, Olsen and Jaksha, 1981

Date mon/day/year	Origin time GMT hr/min/secs		Approximate location lat°N.	long°W.	Magni-tude	Maximum intensity (Modified Mercalli)
Apr.28,1868			34.00	107.00	4.6	V
Apr. 1869			34.10	107.00	5.6	VII
1879			34.05	107.00	4.6	V
Jul. 6,1886			34,00	107.05	4.6	V
May 3,1887	22	50	30.81	109.21	8.1	XII
Jul.12,1893	13	30	35.00	106.40	4.6	V
Sep. 7,1893			34.70	106.60	5.6	VII
Oct. 7,1895			34.50	106.70	4.6	V
Oct.31,1895	12		34.05	107.05	5.1	VI
1897			33.95	107.00	5.1	VI
Jan.20,1904	2	10	33.95	107.05	5.1	VII
Jan.20,1904	9		34.10	107.10	4.6	V
Jan.30,1904	12	30	34.10	107.05	4.6	V
Mar. 9,1904	7	30	34.10	107.00	4.6	V
Sep. 6,1904	11	30	34.10	106.95	4.6	V
Jul. 2,1906	10	15	34.15	107.10	5.1	VI
Jul.12,1906	12	15	33.95	106.95	6.1	VII to VIII
Jul.16,1906	19		34.00	106.95	6.1	VIII
Nov.15,1906	12	15	34.05	106.95	6.1	VIII
Jul.18,1913			34.00	107.00	-	?
Dec. 6,1913	0	15	34.10	106.80	-	?
May 28,1918	11	30	35.45	106.10	5.6	VII
Feb. 1,1919	20	30	34.00	107.10	4.6	V
Aug.13,1924	4	23	36.00	104.50	4.6	V
Dec. 3,1930	21	36	35.00	106.40	5.1	V to VI
Feb. 3,1931	23	45	35.10	106.45	4.6	V
Feb. 5,1931	4	48	35.00	106.45	5.1	VI
Jan. 8,1934	1	32	34.05	107.10	4.6	V
May 7,1934	5	22	32.70	108.20	4.6	V
Feb.21,1935	1	25	34.50	106.80	5.1	VI
Feb.21,1935	3	5	34.55	106.80	4.6	V
Dec.18,1935	5	33	34.80	106.80	5.1	V to VI
Dec.19,1935	1	57	34.80	106.85	5.1	V to VI
Sep.17,1938	17	20	33.20	108.60	5.1	VI
Sep.20,1938	5	40	33.25	108.60	4.6	V
Sep.29,1938	23	34	33.25	108.65	4.6	V
Nov. 1,1938	1	26	33.00	108.70	5.1	V to VI
Nov.27,1938	0	13	33.20	108.65	4.6	V
Dec.28,1938	22	7	33.20	108.70	4.6	V
Jun. 4,1939	1	15	33.25	108.75	4.6	V
Aug. 4,1941	7	40	34.15	107.05	4.6	V
Nov. 6,1947	16	50	35.00	106.40	5.1	VI
May 23,1949	7	22	34.60	105.20	5.1	VI
Aug. 3,1952	20	42	36.50	105.00	4.6	V
Aug.17,1952	10	45	35.50	106.20	4.6	V
Oct. 7,1952	9	20	37.00	106.00	4.6	V

Table 2, cont.

Date mon/day/year	Origin time GMT hr/min/secs			Approximate location lat°N.	long°W.	Magni-tude	Maximum intensity (Modified Mercalli)
Nov. 3,1954	20	39		35.10	106.70	4.6	V
Aug. 3,1955	6	39	42.0	37.00	107.30	5.1	VI
Aug.12,1955	16	20		35.70	106.10	4.6	V
Apr.26,1956	3	30		35.10	106.30	4.6	V
Jul.22,1960	15	49		34.30	106.85	4.6	V
Jul.23,1960	14	15		34.35	106.85	5.1	VI
Jul.24,1960	10	37		34.30	106.80	4.6	V
Jul. 3,1961	7	6		34.10	106.95	5.1	VI

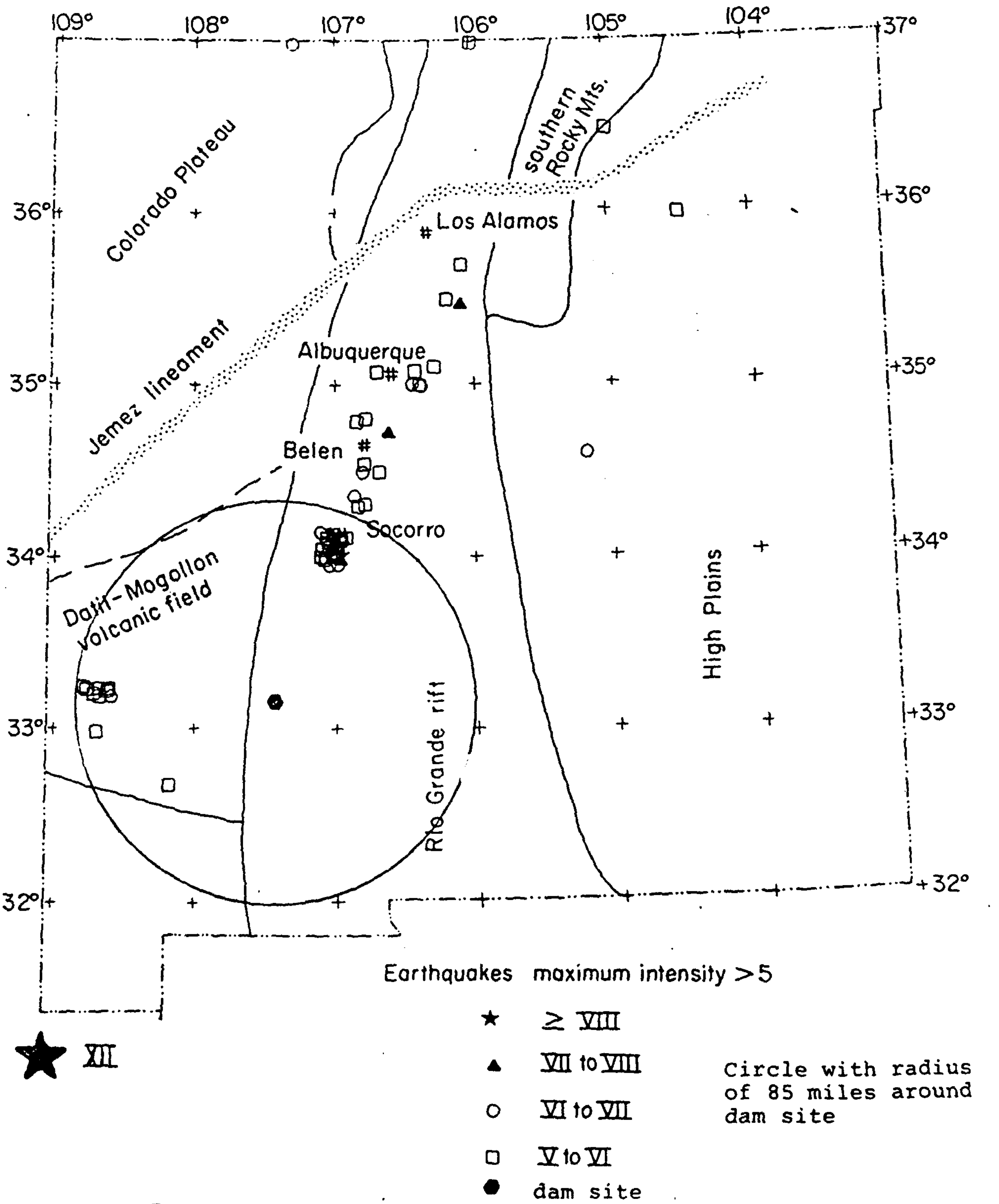


FIGURE 7—LOCATIONS OF EARTHQUAKES REPORTED PRIOR TO 1962 with maximum intensities of V or greater. Also shown on the map are the major physiographic provinces in New Mexico. From Sanford, Olsen and Jaksha, 1981

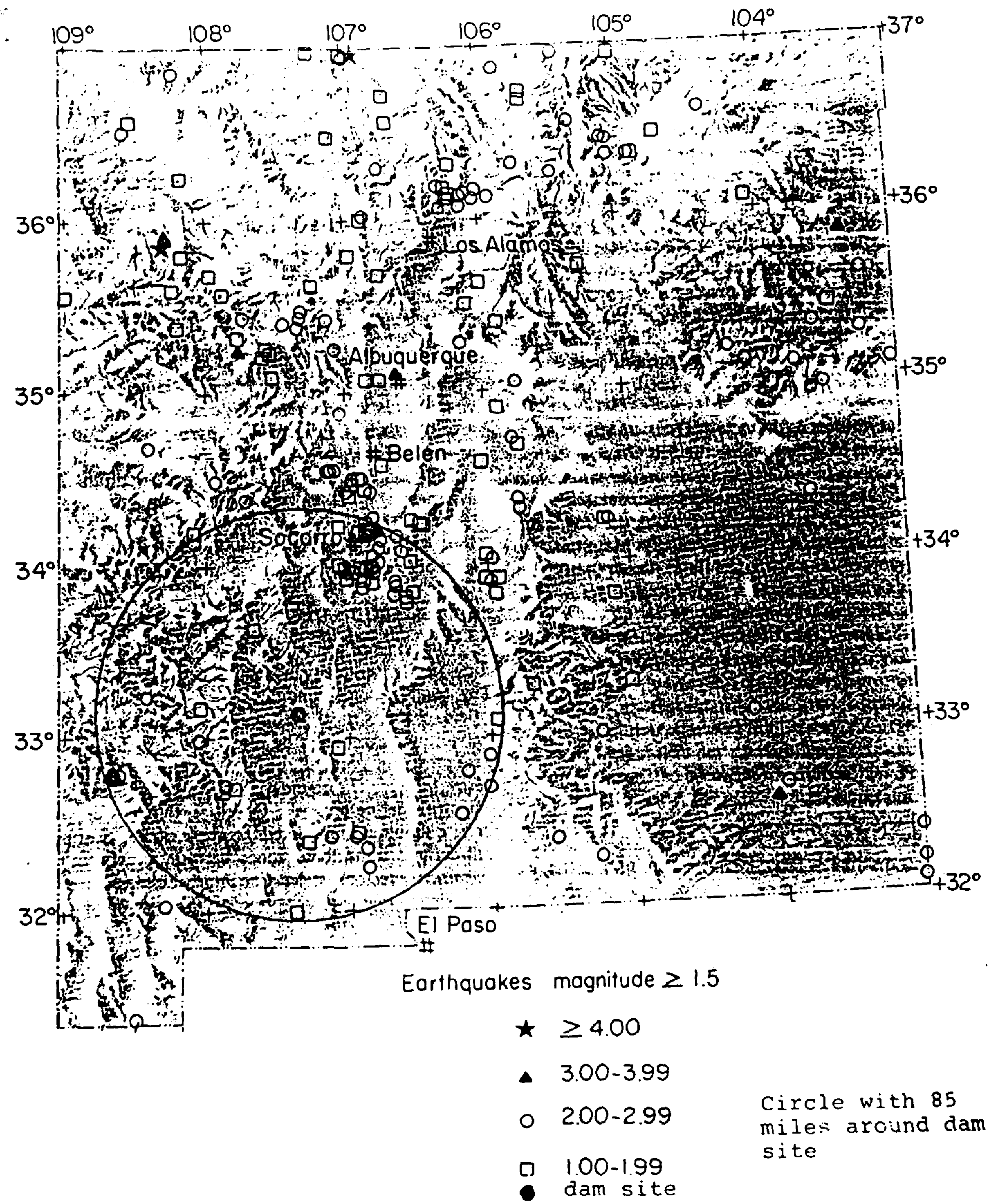


FIGURE 8–INSTRUMENTAL EPICENTERS FOR EARTHQUAKES ($M_L \geq 1.5$) recorded during the period 1962-1977.
From Sanford, Olsen and Jaksha, 1981

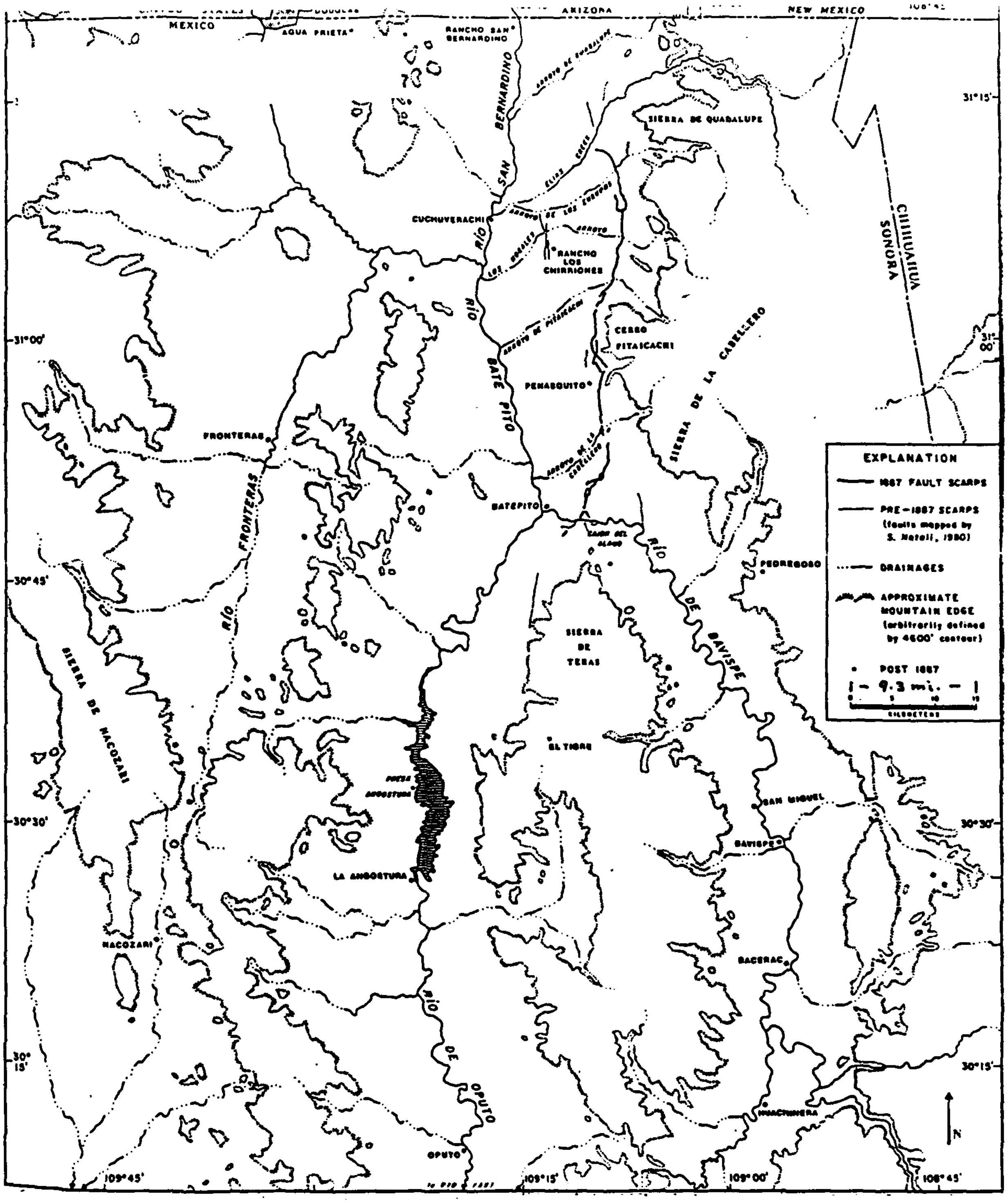
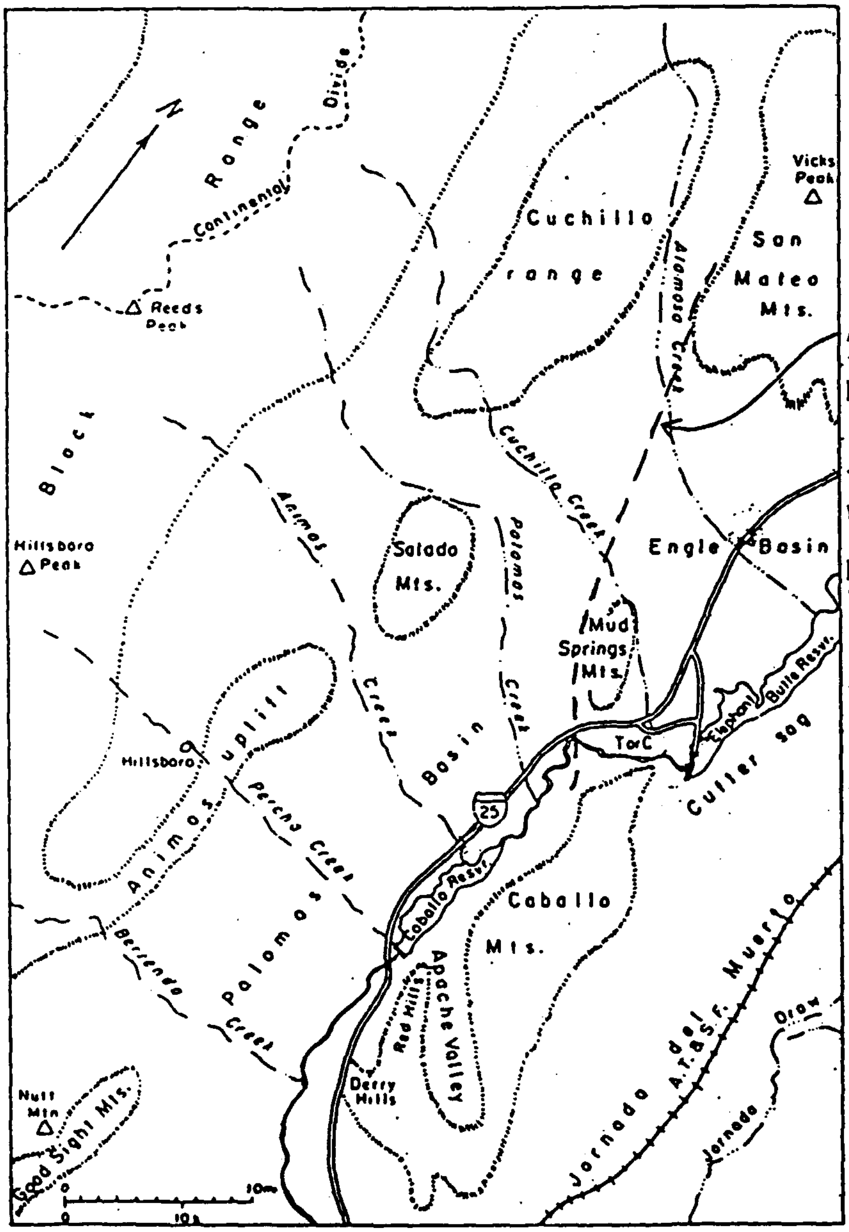


Figure 9
Area of San Bernardino Valley, Sonora, Mexico. The epicenter for the May 3, 1887 earthquake (mM XII) was somewhere between Batepito and Bavispe. From DuBois and Smith, 1980



Approximate location of fault trending N.W. on west side of Mud Springs Mountains Location is approximate as there is no surface expression. The fault probably joins up with range bounding fault on the west side of the San Mateo mountains. The range bounding fault is visible in the San Mateo Mountains. The southern boundary of the fault is probably the Hot Springs fault or it might be part of the Hot Springs fault system. (See Figure 3)

FIGURE 10

SECTION 4 - CONCLUSIONS

4.1 GENERAL

The objective of this study was to determine the maximum earthquake. This has been accomplished by: 1) A study of regional and local geology in order to identify capable faults and assess the magnitude of events that might be associated with rupture of these faults. 2) A seismic risk study which includes historical seismicity as well as geologic data.

4.2 MAXIMUM EARTHQUAKE

Based upon historic and geologic evidence (fault size), the maximum earthquake that could occur would be felt at the Cuchillo Negro Dam site as an Intensity VIII or magnitude 6 event, from within the Mud Springs Mountain Fault Zone. This event could produce peak accelerations of up to 0.4 G's, a peak ground velocity of up to 1.2 ft/sec and a peak displacement up to 0.5 feet, wih a duration of 11 seconds.

References Cited

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Probability of Combined Earthquake and Flood

PROBABILITY OF THE COMBINED OCCURRENCE OF A SEISMIC EVENT AND FLOOD RISK-STORAGE

5.1 The probability of an earthquake and flood-storage occurring simultaneously during the lifetime of a dam depends upon the return periods (frequency of occurrence) of the earthquake and the flood, the duration of the floodwater storage, and the expected design life of dam. Combined risk in this report is defined as the probability of the simultaneous occurrence of an earthquake and flood storage at least once during the lifetime of the dam. The following equation developed by Hynes (1978), was used to compute the combined risk for such an event:

$$\text{Combined Risk} = 1 - 1 - \left\{\frac{1}{T_j} \quad 1 - \left(1 - \frac{1}{52T_i}\right)^{n} \right]\right\}^{K}$$

Where:

T_i = Annual return period of an earthquake exceeding magnitude i.

T_j = Annual return period of a flood exceeding storage level j.

n = Duration of floodwater storage in weeks.

K = Design lifetime of dam.

5.2 An anticipated life of 100 years was assumed for the project. Duration of floodwater storage was based on the PMF year flood routing. The duration of storage, n, used in the calculations was the PMF routing of 84 hours total duration. The SPF routing was only slightly shorter in duration at 77 hours. The duration of flows over the spillway crest are 33 and 19 hours respectively for the PMF and SPF. The PMF routing was the most conservative figure and was used for all of the calculations. Flood return periods of 10, 20, 50 and 100 years were used in the calculations. In order to present comparative levels of risk, three different earthquake return periods were used to compute combined risk. The results are summarized in the table below.

COMBINED RISK OF SIMULTANEOUS OCCURRENCE
OF FLOOD STORAGE AND EARTHQUAKES
Design Life K = 100 Years

CONDUIT INVERT (NGVD)	FLOOD RETURN PERIOD T_j (YEARS)	DURATION OF STORAGE n (WEEKS)	EARTHQUAKE RETURN PERIOD T_i (YEARS)	ASSUMED COMBINED RISK PER 100 YEARS.
4681	25	0.5	10	3.84×10^{-3}
4681	50	0.5	10	1.92×10^{-3}
4681	100	0.5	10	9.62×10^{-4}
4681	25	0.5	20	1.92×10^{-3}
4681	50	0.5	20	9.61×10^{-4}
4681	100	0.5	20	4.81×10^{-4}
4681	25	0.5	50	7.69×10^{-4}
4681	50	0.5	50	3.85×10^{-4}
4681	100	0.5	50	1.92×10^{-4}
4681	25	0.5	100	3.85×10^{-4}
4681	50	0.5	100	1.92×10^{-4}
4681	100	0.5	100	9.62×10^{-5}

Reference: Hynes, M.E., "Notes on Joint Occurrence of Earthquakes and Floods", U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, March 1978.

Geophysical Investigation Report

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P.O. BOX 631
VICKSBURG, MISSISSIPPI 39180-0631

REPLY TO
ATTENTION OF
CEWES-GH-I

8 JUL '87

MEMORANDUM FOR: Commander, U.S. Army Engineer District, Albuquerque, ATTN: CESWA-ED-TA (Mr. Jim McAdoo), P.O. Box 1580, Albuquerque, NM 87103-1580

SUBJECT: Transmittal of Geophysical Test Results, Cuchillo Negro Dam Site, New Mexico

1. As requested by Mr. Jim McAdoo of your office, I am sending you the results from the geophysical investigation conducted at Cuchillo Negro Dam Site, New Mexico (encl 1).

2. If you have any questions, please contact Mr. T. B. Kean II (FTS 542-2961) or Mr. J. R. Curro, Jr. (FTS 542-2235), respectively.

FOR THE COMMANDER AND DIRECTOR:

Encl

Robert W. Whalin

ROBERT W. WHALIN, PhD, PE
Technical Director

HYDRAULICS LABORATORY | GEOTECHNICAL LABORATORY | STRUCTURES LABORATORY | ENVIRONMENTAL LABORATORY | COASTAL ENGINEERING RESEARCH CENTER | INFORMATION TECHNOLOGY LABORATORY

GEOPHYSICAL INVESTIGATION AT THE CUCHILLO NEGRO DAM SITE, NEW MEXICO

Background

1. During the period 25 March through 1 April 1986, personnel from the Earthquake Engineering and Geophysics Division, Geotechnical Laboratory, U.S. Army Engineer Waterways Experiment Station, conducted surface seismic refraction tests in support of the U.S. Army Engineer District, Albuquerque (CESWA), Cuchillo Negro Dam Site project. The purpose of these tests was to determine the compression-wave (P-wave) velocities of the in-situ material and the depth to competent rock in the proposed left abutment area. These data will be used in conjunction with other geotechnical studies to be performed by the CESWA, to determine the best location for the left abutment and to develop a construction excavation plan.

Site Description

2. The site was located in Serra County, New Mexico, along the Cuchillo Negro Creek near Truth or Consequences, New Mexico. The site was divided into two areas of investigation. Each of the two areas consisted of a "finger" or ridge trending away from Cuchillo Creek in a northeasterly direction, as shown in Figure 1. The materials at the site consisted of bedded limestone with layers of shale and sandstone of varying thickness and frequency. This system of limestone, shale, and sandstone is identified as the Santa Fe Formation and dips 20 to 25 degrees to the northeast. The near-surface material was made up of cobbles and sandy clay.

Test procedures and surveys conducted

3. Test procedures and data interpretation techniques were performed in accordance with Appendix B, EM 1110-1-1802, Geophysical Exploration, dated May 1979. In the seismic refraction tests, a seismic signal is generated at or near the ground surface by a small explosive charge or hammer blow to a steel plate. This seismic signal is detected by an array of geophones placed at selected intervals and extending in a straight line on the ground surface away from the source. The geophone responses were recorded using a 12-channel

seismograph. The surface seismic refraction tests were performed to determine the P-wave velocities of the geologic materials at the site and the depths to interfaces between materials with contrasting velocities. The interpretation of the data assumes that velocity increases with depth; thus, it is not possible with a seismic refraction survey to detect velocity inversions, i.e., a low velocity layer underlying a higher velocity layer.

4. Twelve surface seismic refraction lines, designated R1 through R12, were run at the site (See Figure 1). Six of the surveys were conducted on Ridge No. One, and six were conducted on Ridge No. Two. Seismic lines R1, R8, R9, R10, R11, and R12 were 130 ft long and had 10-ft geophone spacings. Seismic lines R4 and R7 were 325 ft long with 25-ft geophone spacings. Lines R2, R3, and R5, were 625 ft in length and line R6 was 575 ft long with 25-ft geophone spacings. The lengths of the lines above are from the source location at one end of the line to the source location at the other end.

Test Results

5. The basic data acquired from the forward and reverse traverses of each line are displayed as conventional P-wave arrival time versus distance (T/D) plots in Figures 2 through 13 for lines R1 through R12, respectively. The P-wave velocity of each layer and depths to layer interfaces beneath the source locations are indicated in the figures under "computed seismic profile." These velocity and depth data were used to construct P-wave velocity profiles for seismic lines R1 through R3 and R11 and R12, as shown in Figure 14, and for lines R5, R6, and R8 through R10 which is presented in Figure 15. Lines R4 and R7 were run perpendicular to the lines in the profiles as shown in Figure 1, therefore will be discussed separately.

6. Referring to Figure 14, a four-layer profile appeared to exist for Ridge No. One. The near-surface material exhibited velocities ranging from 940 to 1,300 fps and had a thickness of 1.5 to 3.5 ft. Layer Two had velocities ranging from 2,000 to 2,240 fps and extended to depths varying between 11 and 24 ft where the third layer began and extended to depths varying from 91 to 118 ft with a velocity range of 4,340 to 6,510 fps. The fourth layer exhibited a velocity range of 11,250 to 11,660 fps and extended to an undetermined depth. This layer is considered to be competent rock.

7. For line R4, the data presented in the T/D plot (Figure 5) showed two velocity layers. The first zone had a velocity of 1,870 fps where the second layer exhibited a 4,870 fps velocity. These velocities agree well with those for layers 2 and 3 of the pofile in Figure 14. Since shotholes and 25-ft geophone spacings were used in the conduct of line R4, the near-surface layers (940-1,300 fps) in Figure 14 was probably not detected, therefore the depths presented above may be slightly shallow.

8. Referring to Figure 15, a five-layer velocity profile was interpreted for Ridge No. Two. The near-surface materials of Zone One had velocities ranging from 1,170 to 1,450 fps with thicknesses varying from 1.5 to 8.5 ft. The underlying layer, with velocities ranging from 2,120 to 2,510 fps, extended to depths between 14 and 17.5 ft. Zone Three, with velocities ranging from 3,160 to 4,960 fps, extended to depths varying from 32.5 to 69.5 ft. Layer Four exhibited velocities of 7,000 to 7,790 fps and extended to depths between 112 and 122 ft where the fifth zone was encountered with velocities ranging between 10,140 to 11,510 fps and extended to an undetermined depth. This latter zone is indicative of competent rock.

9. For line R7, the data in the T/D plot (Figure 8) indicated a three-layer velocity system. The first layer had a velocity of 2,090 fps and extended to depths of 6 to 18 ft. The second zone exhibited a 3,190 fps velocity to depths varying between 34.5 and 38.5 ft where a 7,630 fps zone was detected to an undetermined depth. These velocities agree well with those for Zones 2, 3, and 4 of the profile in Figure 15. Since shotholes and 25-ft geophone spacings were used in the conduct of line R7, it is possible that the near-surface zone (1,170-1,450 fps) shown in Figure 15 was not detected, therefore the depths presented above may be slightly shallow.

Conclusions

10. The following conclusions were drawn from the seismic investigation conducted at the site:

   a. Ridge one had a four-layer P-wave velocity profile. The near-surface zone ranged from 940 to 1,300 fps with thicknesses of 1.5 to 3.5 ft. The second zone had velocities ranging from 2,000 to 2,240 fps and extended to depths ranging between 11 and 24 ft. Zone Three exhibited velocities varying between 4,340 and 6,510 fps and extended to depths of 91 to 118 ft. The fourth zone of 11,250 to 11,660 fps is indicative of competent rock and extended to an undetermined depth.

b. Area Two of this study exhibited a five-layer velocity profile. The first zone had velocities ranging between 1,170 and 1,450 fps. The thickness of this near-surface material ranged between 1.5 and 8.5 ft below the ground surface. Zone Two had velocities of 2,120 to 2,510 fps to depths of 14 to 17.5 ft where Zone Three was encountered with velocities ranging from 3,160 to 4,960 fps to depths varying between 32.5 and 69.5 ft. Zone Four exhibited velocities of 7,000 to 7,790 fps to depths between 112 and 122 ft where the final zone was encountered with velocities of 10,140 to 11,510 fps. This zone is indicative of competent rock.

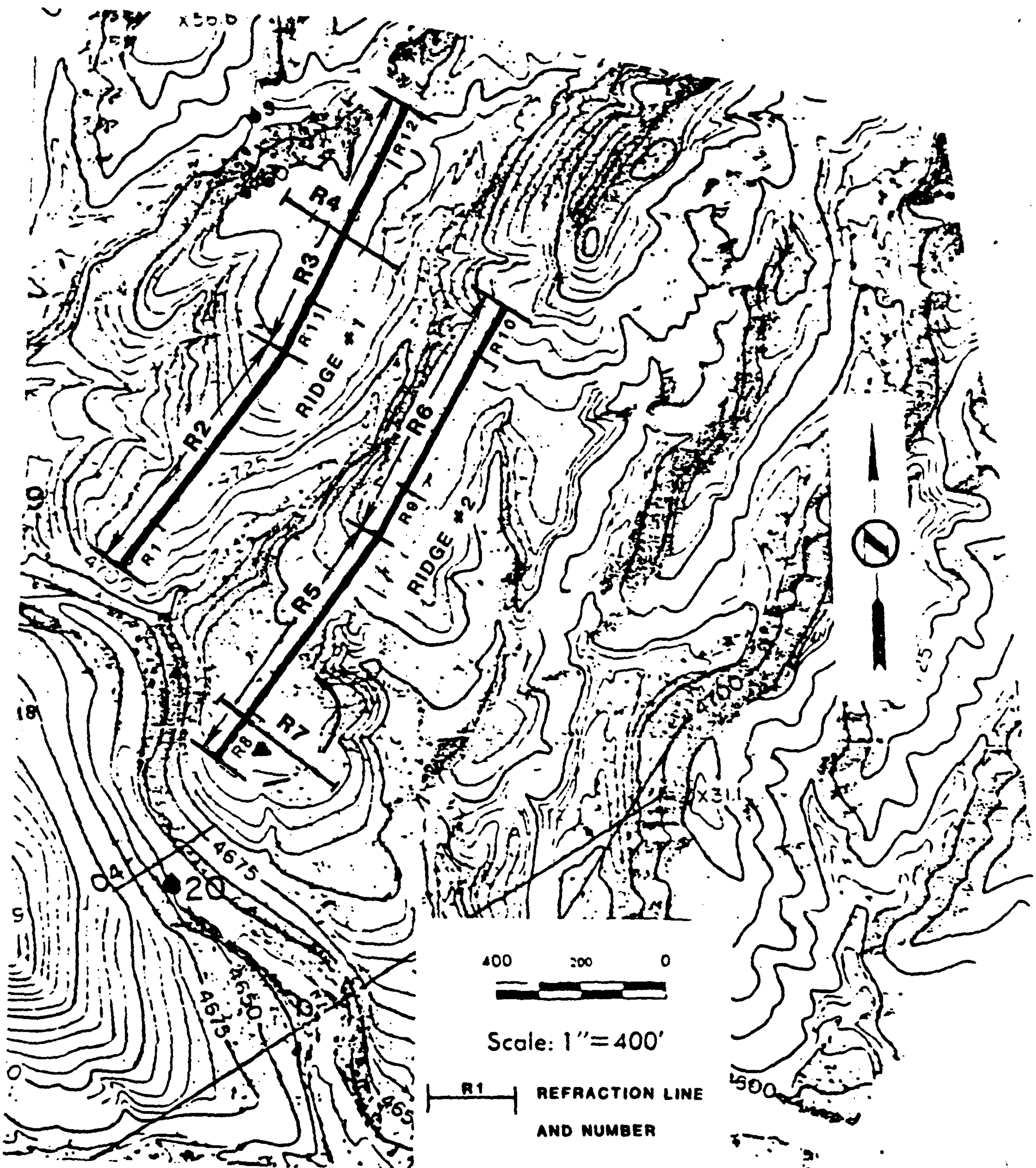
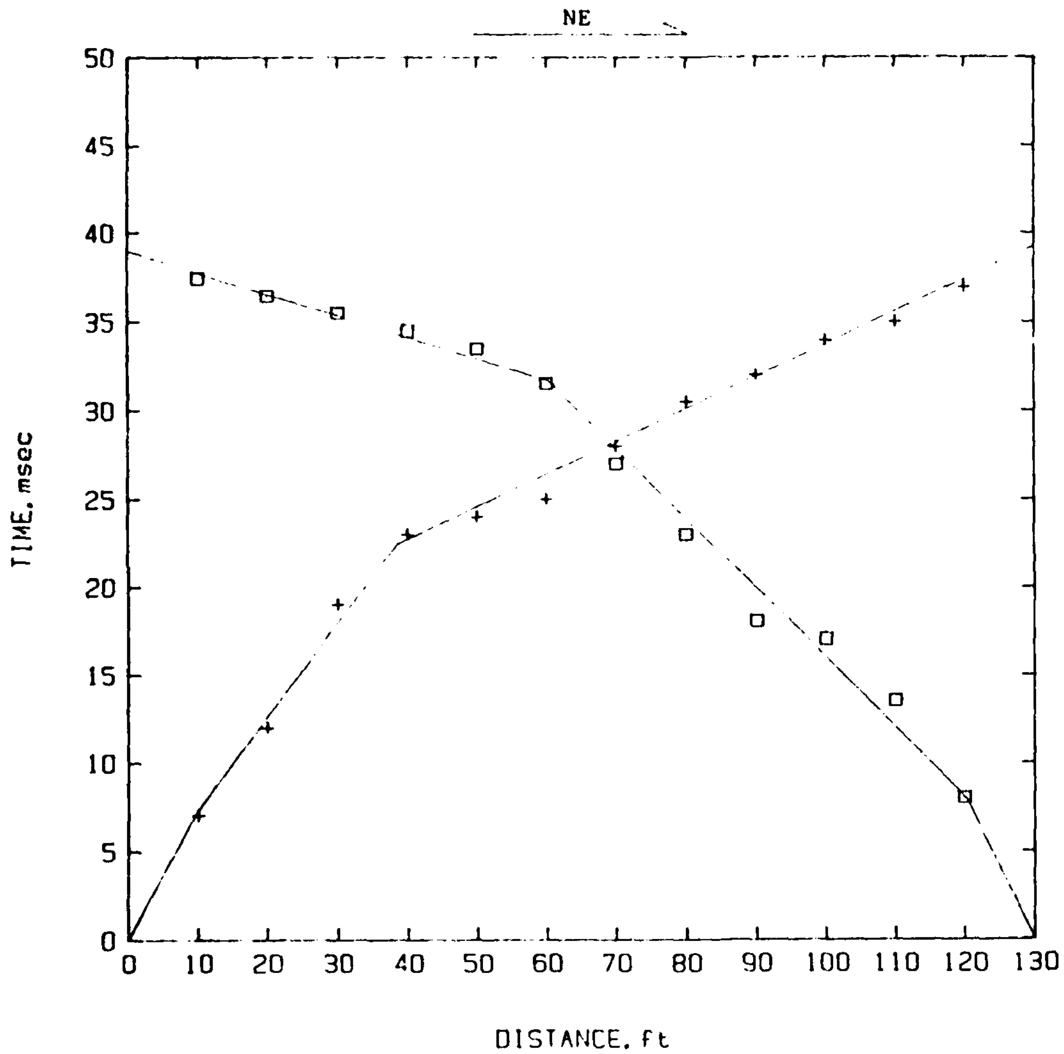


Figure 1. Seismic investigation site map



CNINM

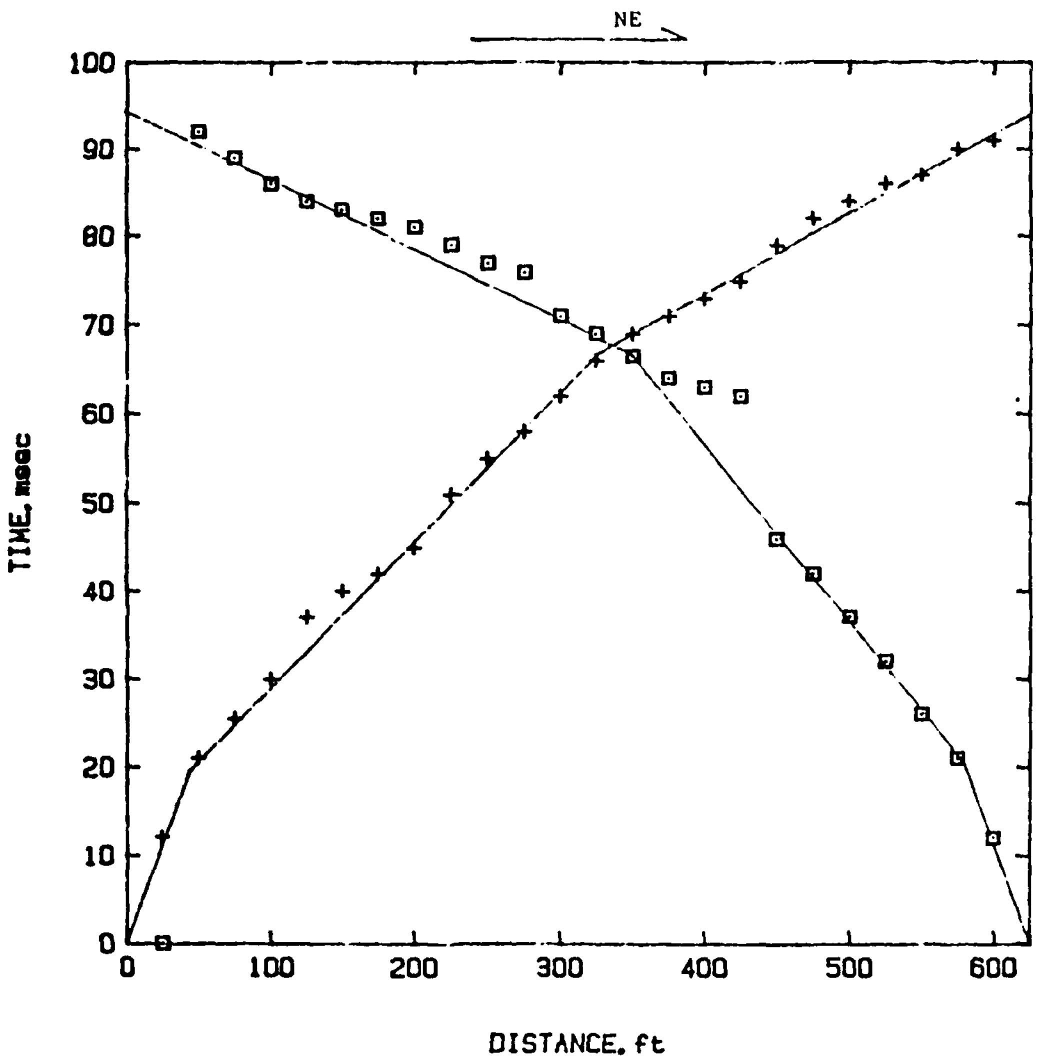
*** INPUT DATA ***

	FORWARD		REVERSE	
LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	1363	0.0	1229	0.0
2	1884	2.0	2529	4.1
3	5444	15.4	8213	23.2

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1300		
2	2140	1.5	3.5
3	6510	16.5	24.0

Figure 2. P-wave arrival time versus distance, Line R1



CH2NM

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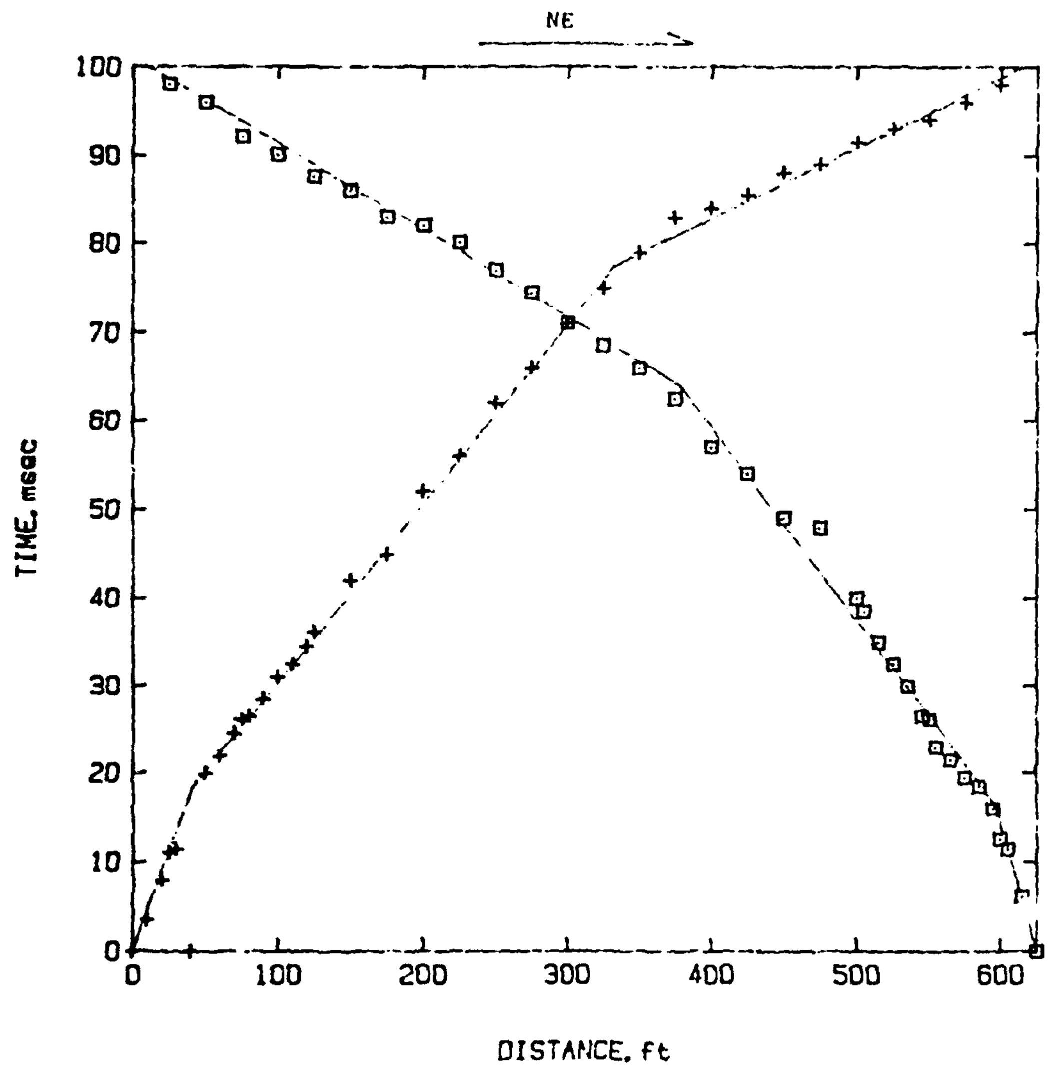
	FORWARD		REVERSE	
LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	2249	0.0	2238	0.0
2	5981	12.2	4988	11.3
3	11008	37.2	12870	44.9

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	2240		
2	5430	15.0	14.0
3	11660	89.5	115.0

Figure 3. P-wave arrival time versus distance, Line R2



CN3NM11

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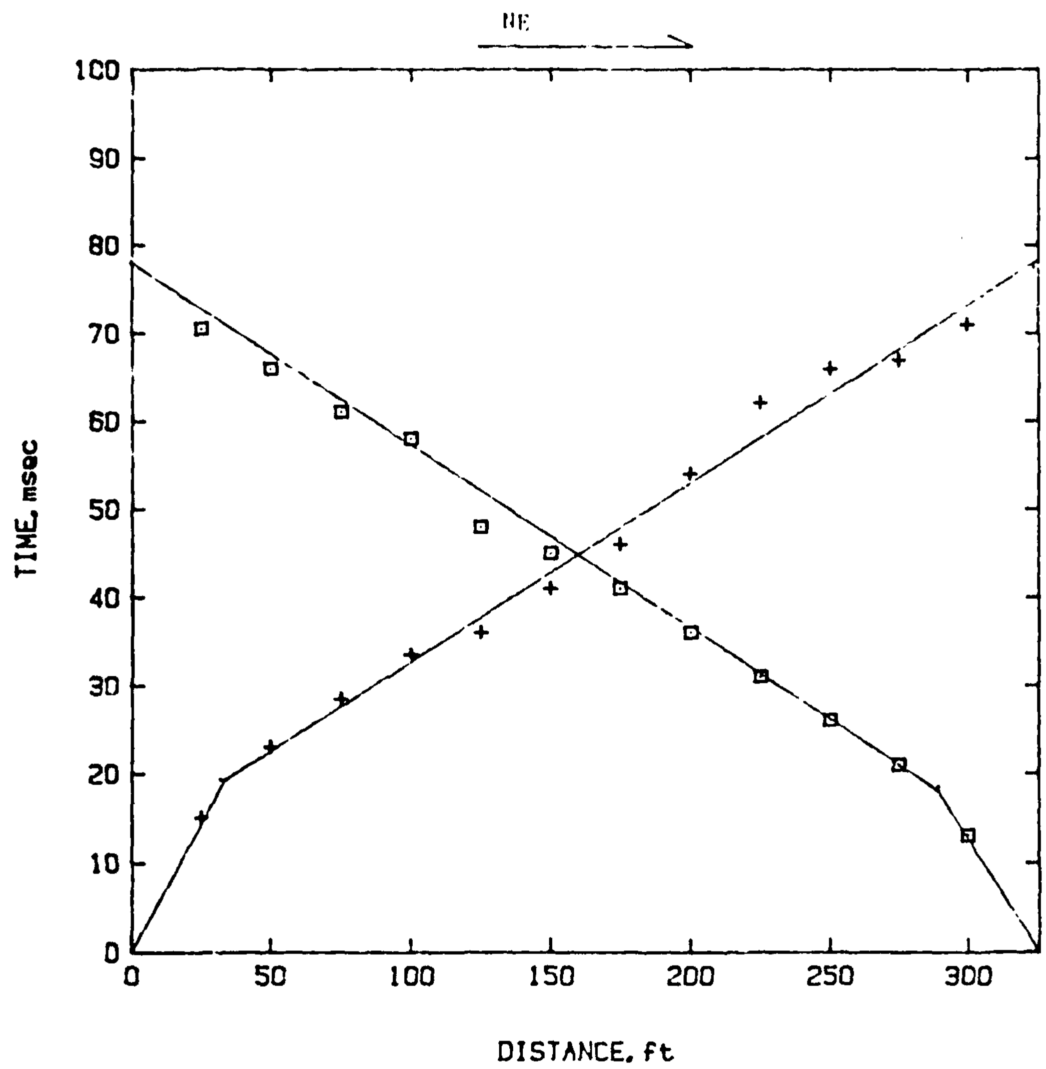
	FORWARD		REVERSE	
LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	2250	0.0	1759	0.0
2	4933	9.9	4578	10.0
3	12522	50.9	10228	39.9

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	2000		
2	4740	11.0	11.0
3	11250	116.0	87.0

Figure 4. P-wave arrival time versus distance, Line R3



CN4NM

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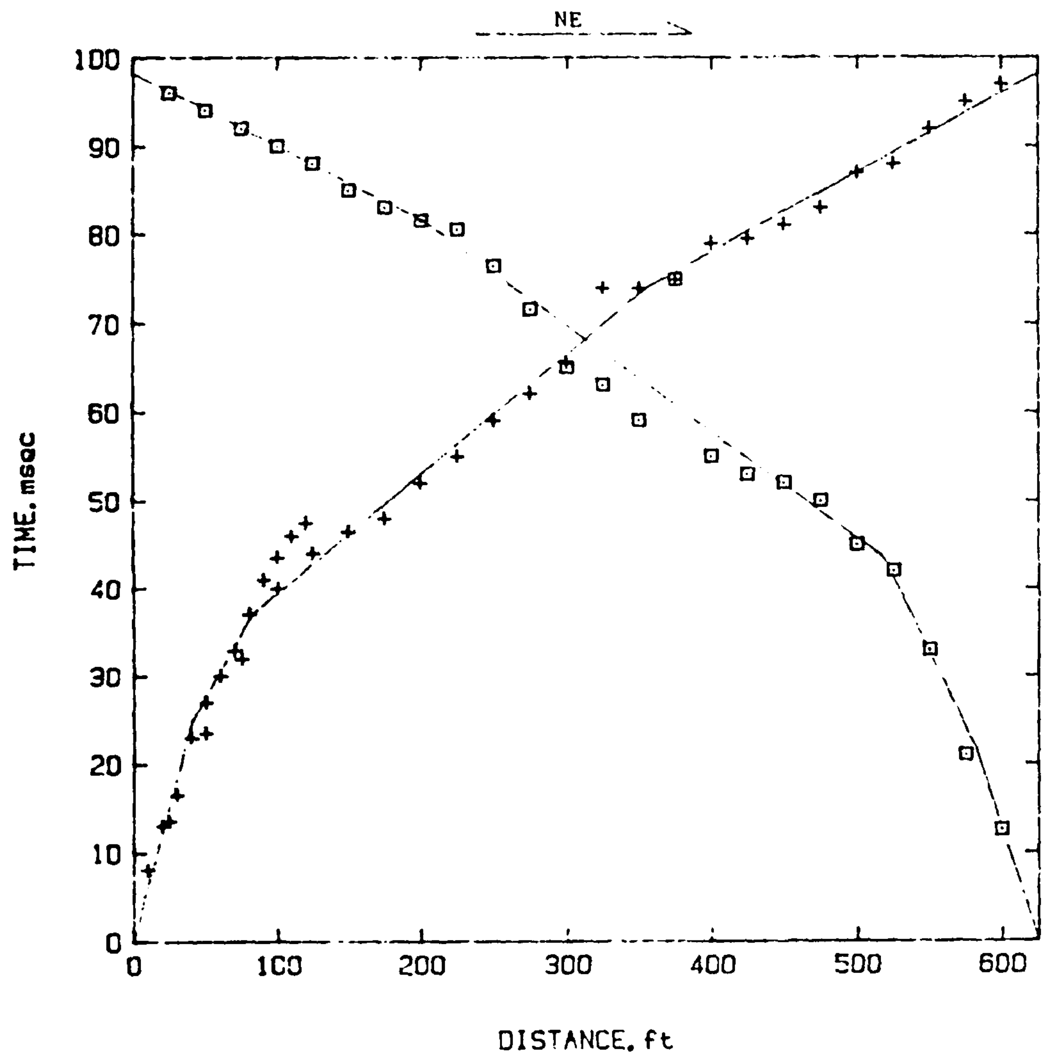
LAYER #	FORWARD VEL. FT/S	FORWARD TI. MSEC	REVERSE VEL. FT/S	REVERSE TI. MSEC
1	1748	0.0	1885	0.0
2	4838	12.4	4823	10.8

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1870		
2	4870	12.5	10.5

Figure 5. P-wave arrival time versus distance, Line R4



CNSNMB

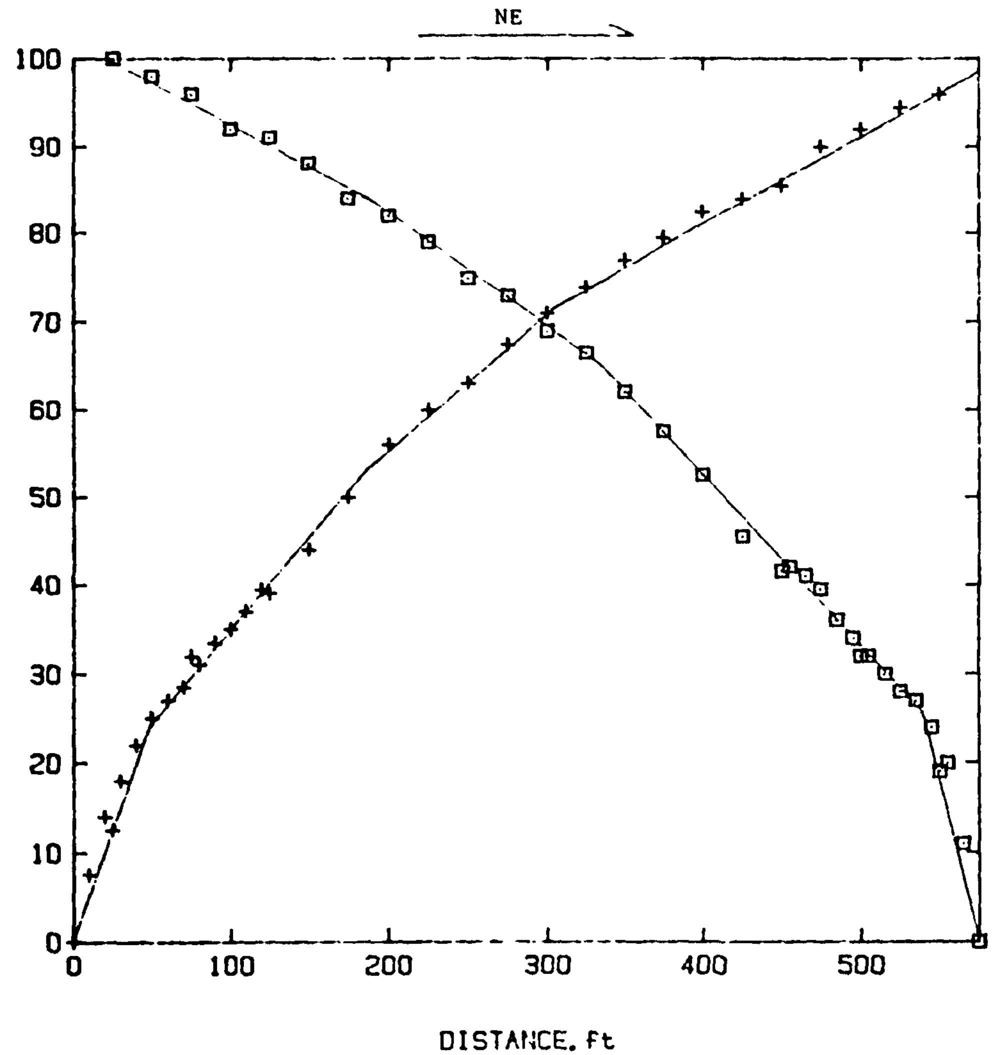
*** INPUT DATA ***

	FORWARD		REVERSE	
LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	1837	0.0	1984	0.0
2	3420	13.0	2954	7.1
3	7387	25.9	8341	30.7
4	11173	42.3	12013	48.3

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1810		
2	3180	14.5	8.0
3	7790	32.5	48.5
4	11510	115.0	122.0

Figure 6. P-wave arrival time versus distance, Line R5



CN6NM9

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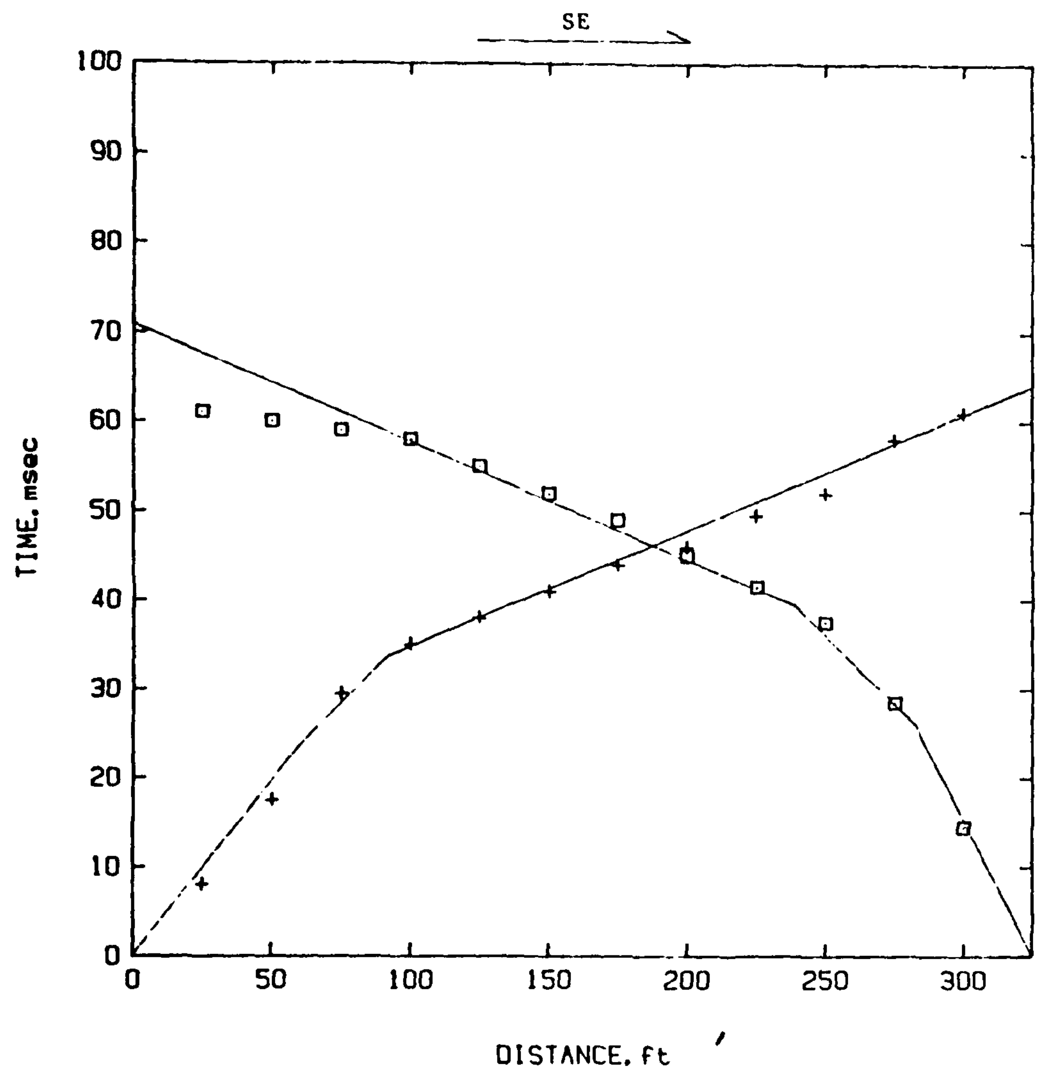
LAYER #	FORWARD VEL. FT/S	FORWARD TI. MSEC	REVERSE VEL. FT/S	REVERSE TI. MSEC
1	2020	0.0	1400	0.0
2	4780	13.9	5181	18.7
3	8387	23.9	7780	34.2
4	10027	41.2	10402	46.8

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1710		
2	4860	12.5	17.0
3	7000	46.0	89.5
4	10140	118.0	112.0

Figure 7. P-wave arrival time versus distance, Line R6



CN7NM

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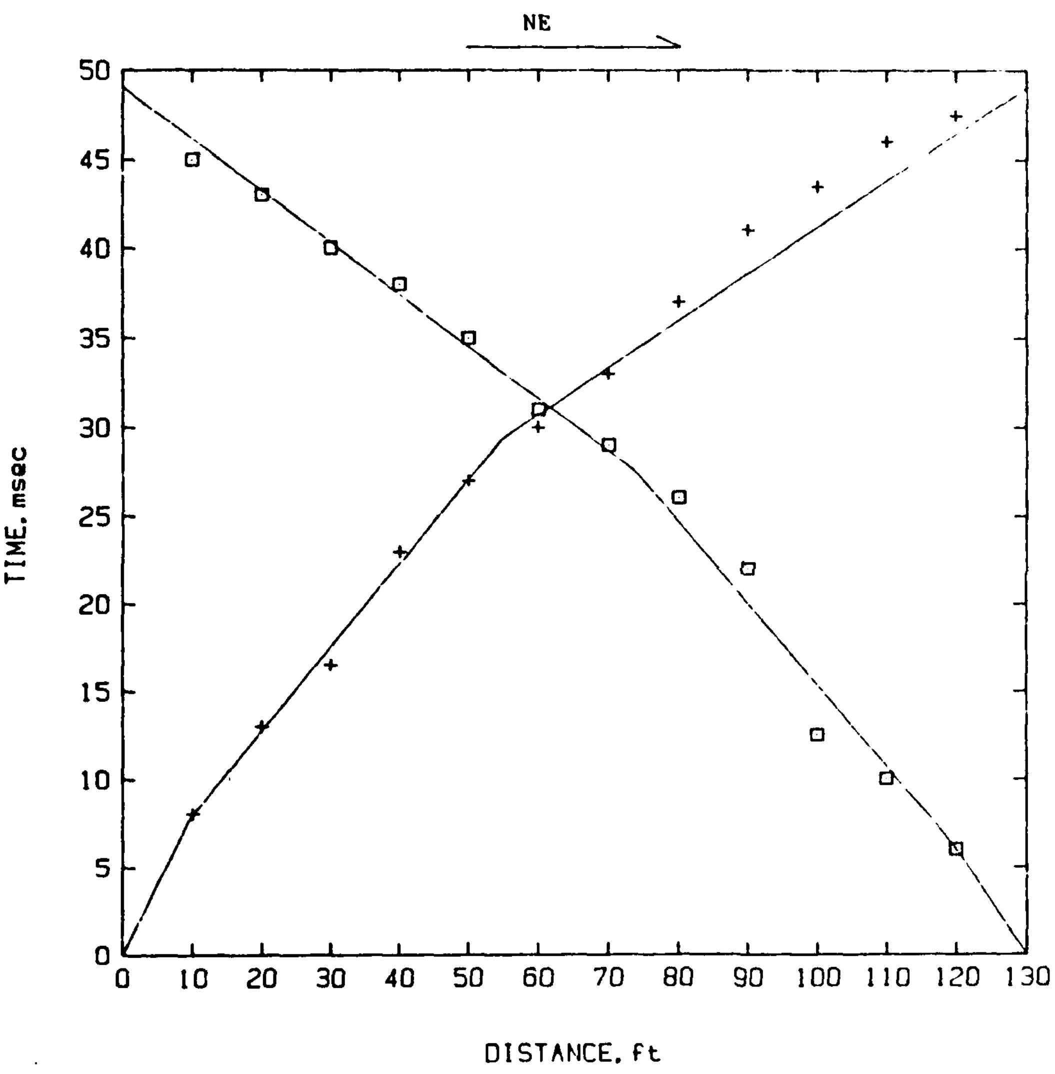
	FORWARD		REVERSE	
LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	2545	0.0	1835	0.0
2	3148	4.5	3240	12.9
3	7688	21.8	7588	28.1

*** COMPUTED SEISMIC PROFILE ***

		DEPTH	
LAYER #	TRUE VEL. FT/S	FOR. FT.	REV. FT.
1	2090		
2	3190	6.0	18.0
3	7830	34.5	38.5

Figure 8. P-wave arrival time versus distance, Line R7



CNBNM

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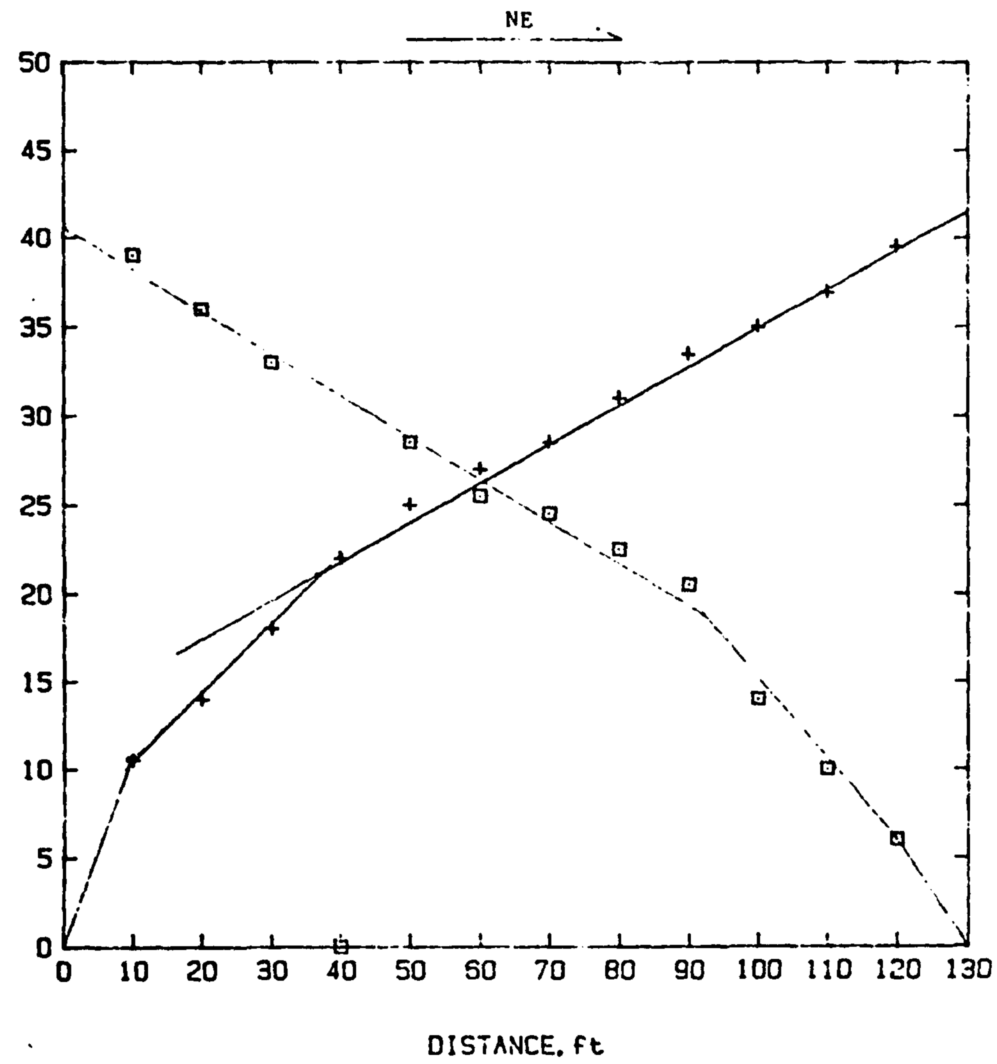
LAYER #	FORWARD VEL. FT/S	FORWARD TI. MSEC	REVERSE VEL. FT/S	REVERSE TI. MSEC
1	1244	0.0	1858	0.0
2	2094	3.2	2152	1.4
3	3817	15.0	3433	11.2

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1450		
2	2120	3.0	1.5
3	3600	17.5	14.0

Figure 9. P-wave arrival time versus distance, Line R8



CN9NM

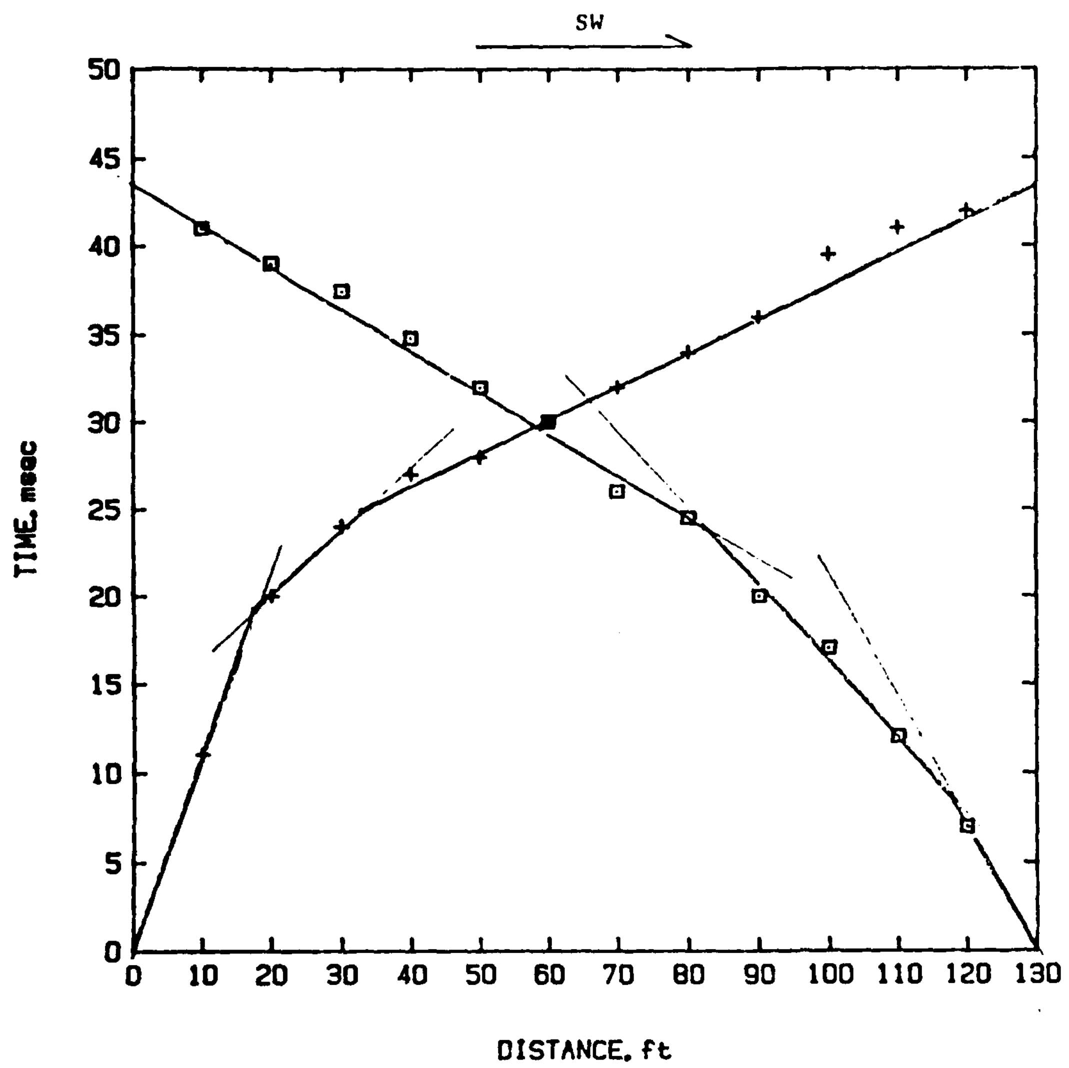
*** INPUT DATA ***

LAYER #	FORWARD VEL. FT/S	FORWARD TI. MSEC	REVERSE VEL. FT/S	REVERSE TI. MSEC
1	931	0.0	1882	0.0
2	2578	8.7	2179	1.4
3	4585	13.0	4238	9.9

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1310		
2	2350	5.0	1.0
3	4380	12.5	12.5

Figure 10. P-wave arrival time versus distance, Line R9



CN10NM

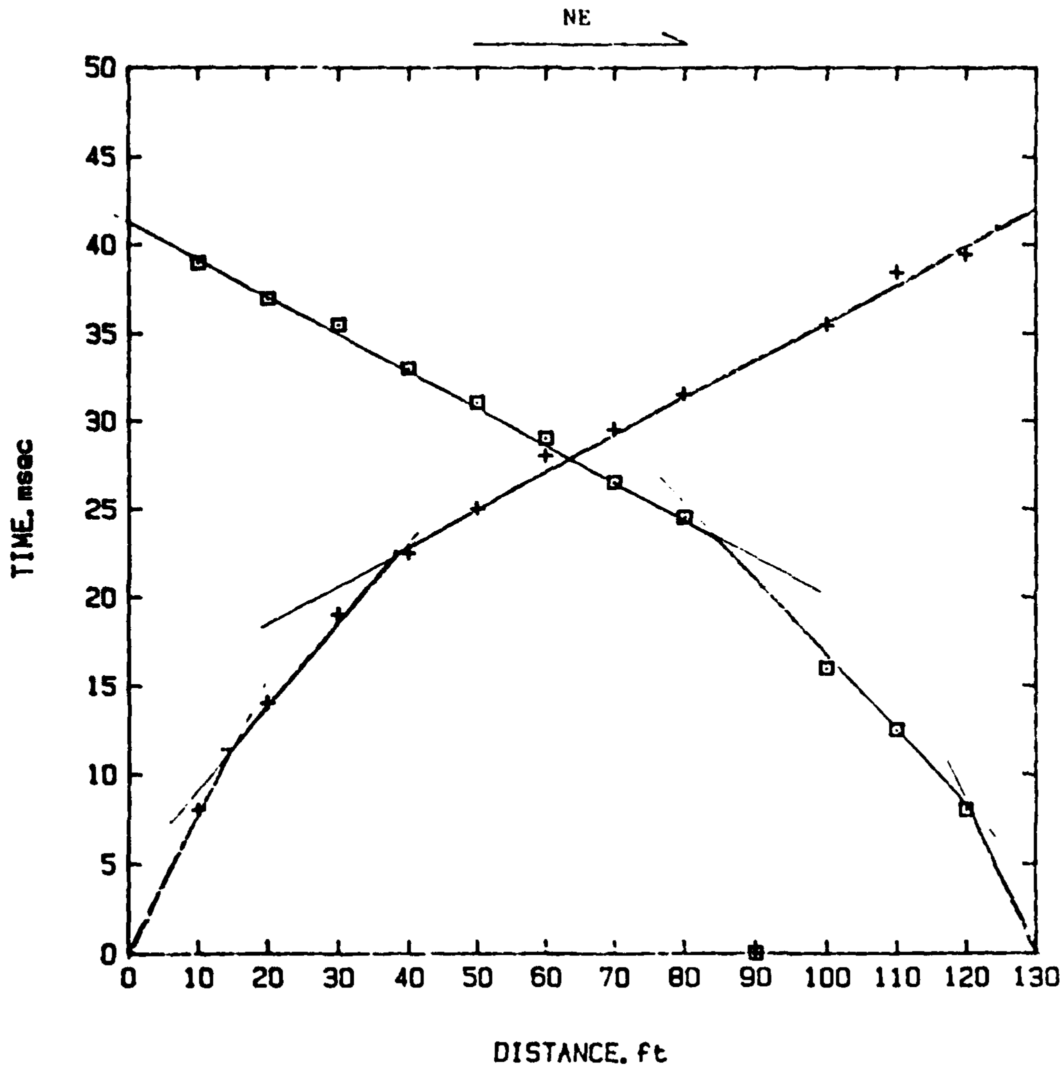
*** INPUT DATA ***

LAYER #	FORWARD VEL. FT/S	FORWARD TI. MSEC	REVERSE VEL. FT/S	REVERSE TI. MSEC
1	909	.0	1431	.0
2	2802	13.0	2295	3.2
3	5248	18.6	4200	12.8

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1170		
2	2510	8.5	2.0
3	4650	15.0	15.5

Figure 11. P-wave arrival time versus distance, Line R10



CN11NM

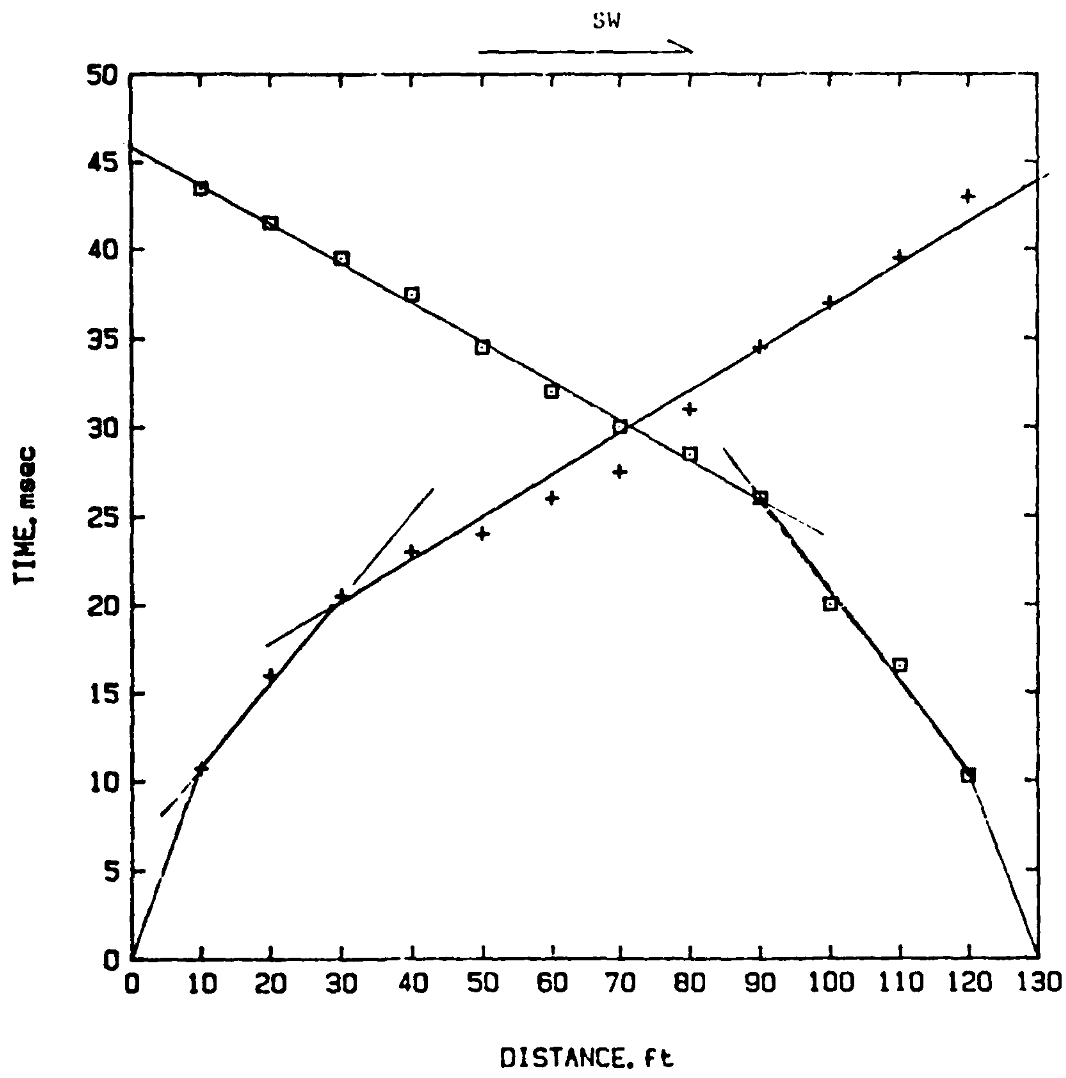
*** INPUT DATA ***

LAYER #	FORWARD VEL. FT/S	FORWARD TI. MSEC	REVERSE VEL. FT/S	REVERSE TI. MSEC
1	1295	0.0	1181	.0
2	2118	4.4	2378	4.1
3	4877	14.3	4707	13.7

*** COMPUTED SEISMIC PROFILE ***

LAYER #	TRUE VEL. FT/S	DEPTH FOR. FT.	DEPTH REV. FT.
1	1240		
2	2230	3.5	3.0
3	4880	15.0	14.5

Figure 12. P-wave arrival time versus distance, Line R11



CN12NM

*** INPUT DATA ***

	FORWARD		REVERSE	
LAYER #	VEL. FT/S	TI. MSEC	VEL. FT/S	TI. MSEC
1	924	.0	988	0.0
2	2088	6.0	1948	5.2
3	4208	13.1	4503	17.0

*** COMPUTED SEISMIC PROFILE ***

		DEPTH	
LAYER #	TRUE VEL. FT/S	FOR. FT.	REV. FT.
1	940		
2	2010	3.0	3.0
3	4340	10.5	15.5

Figure 13. P-wave arrival time versus distance, Line R12

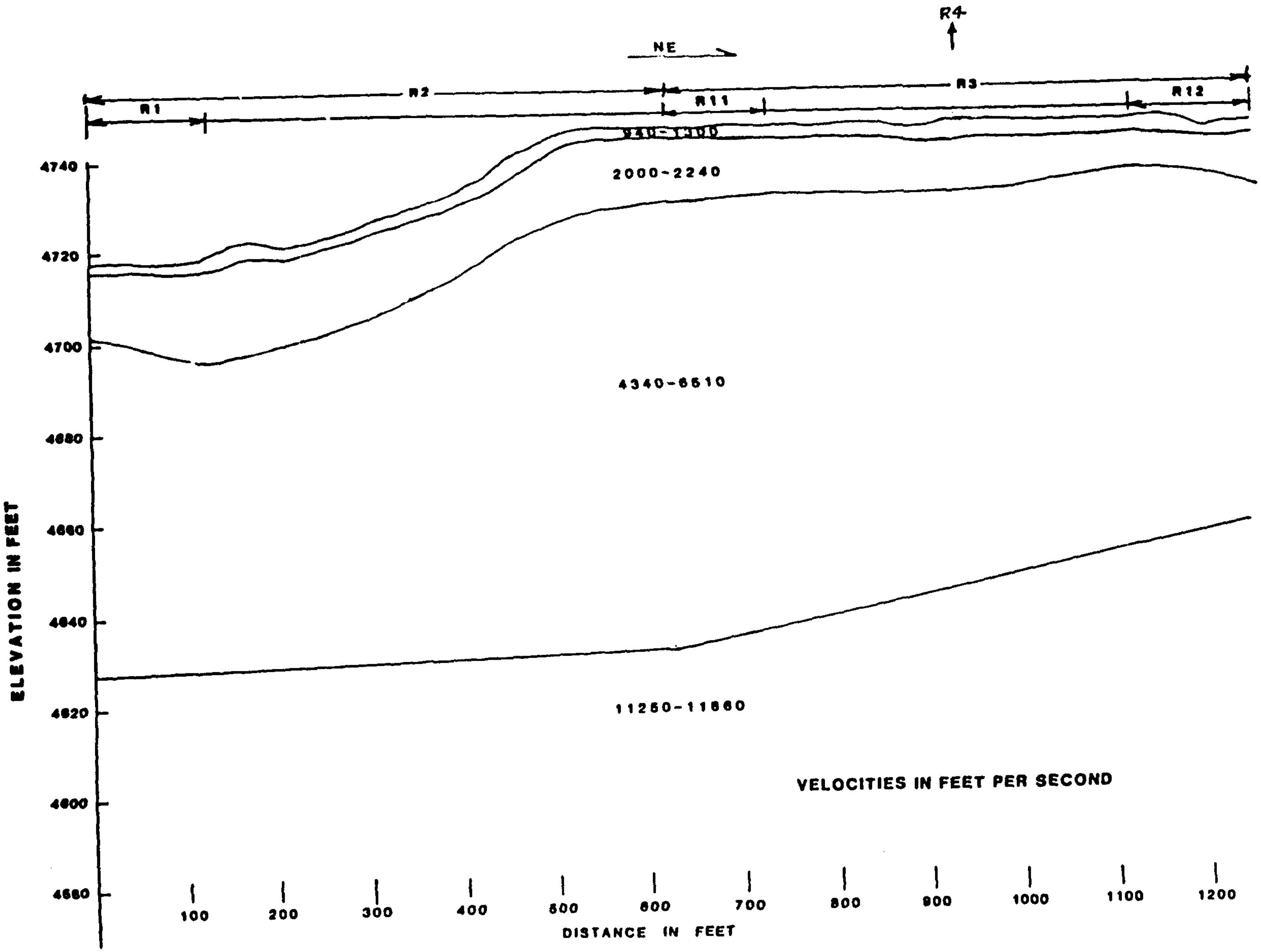


Figure 14. P-WAVE VELOCITY PROFILE OF SEISMIC REFRACTION LINES CONDUCTED ON RIDGE NUMBER 1

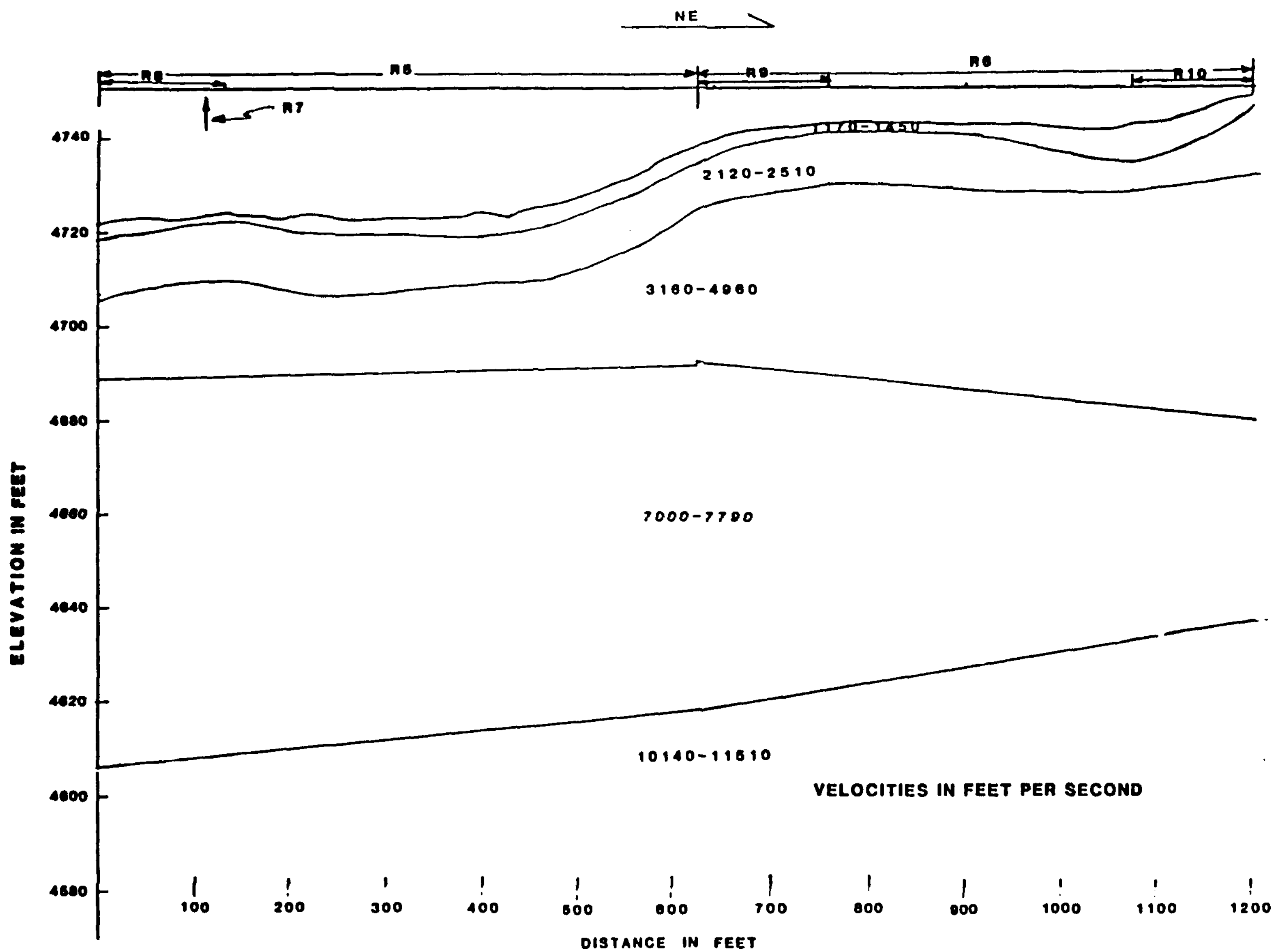


Figure 15. P-WAVE VELOCITY PROFILE OF SEISMIC REFRACTION LINES CONDUCTED ON RIDGE NUMBER 2

Test Results for Borrow Area Material

FOX

FOX & ASSOCIATES OF NEW MEXICO, INC.

CONSULTING ENGINEERS AND GEOLOGISTS

ALBUQUERQUE OFFICE 3412 BRYN MAWR DRIVE. NE
ALBUQUERQUE. NEW MEXICO 87107
(505) 884-0900

July 18, 1984

Corps of Engineers
Construction Branch
P. O. Box 1580
Albuquerque, NM 87103

Job No. 434690

Attention: Mr. Don Luna

Subject: Sieve Analyses, Moistures and Atterberg Limits Tests for Cuchillo Negro Creek, DACW47-83-D-0023, Delivery Order #DM0007 (Item 0002)

Gentlemen:

Transmitted herein is the detailed test data for the subject project.

FOX & ASSOCIATES OF NEW MEXICO, INC.

Larry L. Renfro
Materials & Testing Division Manager

Copies: Addressee (2)

Attached: Data Sheets (2)

jcg

Job No. 434690

Project: Chuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM0007

Sample I.D.	Moisture Percent	Atterberg Limits LL	Atterberg Limits PI	Sieve Analysis % Passing 3"	2"	1½"	1¼"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#80	#200	Soil Description
CN-T-5 #1 @ 0' - 4'	4.5	-	-	-	100	-	-	93	77	63	59	46	33	9	3	1.2	sandy GRAVEL, light brown (GP)
CN-T-5 #2 @ 5.4' - 8'	4.5	-	-	-	-	100	-	-	96	90	77	52	30	10	5	3.5	very sandy GRAVEL, light brown (GP)
CN-T-6 #1 @ 1.3' - 7'	1.6	-	-	-	-	100	-	-	72	63	57	43	33	15	8	4.6	sandy GRAVEL, light brown (GP)
CN-T-6 #2 @ 7' - 9'	7.1	-	-	100	-	88	-	-	72	52	45	32	22	13	9	7.0	sandy GRAVEL, light brown (GP-GM)
CN-T-7 #1 @ 1.2' - 8.3'	2.1	-	-	-	-	100	-	-	81	71	63	50	37	20	11	5.8	very sandy GRAVEL, light brown (GP-GM)
CN-T-7 #2 @ 8.3' - 9.5'	12.8	-	-	-	-	-	-	-	100	97	95	91	86	33	9	4.4	slightly gravelly SAND, light brown (SP)
CN-T-8 #1 @ 0' - 2.4'	3.6	-	-	-	-	100	-	-	86	72	65	54	45	26	11	3.2	very gravelly SAND, light brown (SP)
CN-T-8 #2 @ 2.4' - 8'	1.6	-	-	-	-	100	-	-	99	86	76	48	25	5	3	2.6	very sandy GRAVEL, light brown (GP)
CN-T-8 #3 @ 8'- 8.3'	10.9	29	8	-	-	-	-	-	100	98	97	95	94	92	89	71.5	sandy CLAY, brown (CL)

Job No. 434690

Project: Cuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM0007

Sample I.D.	Moisture Percent	Atterberg Limits LL	PI	Sieve Analysis % Passing 3"	2"	1½"	1¼"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#80	#200	Soil Description
CN-T-8 #4 @ 8.3' - 13.5'	2.7	-	-	-	-	100	-	-	85	75	65	38	19	8	6	3.7	sandy GRAVEL, light brown (GP)
CN-T-9 #1 @ 0' - 2.8'	3.9	-	-	100	-	81	-	-	46	35	28	18	11	3	2	0.3	sandy GRAVEL, light brown (GP)
CN-T-9 #2 @ 2.8' - 9.1'	2.0	-	-	100	-	78	-	-	48	42	38	30	23	10	7	4.9	sandy GRAVEL, light brown (GP)
CN-T-10 #1 @ 0.9' - 3.1'	3.1	NV	NP	100	-	89	-	-	76	70	68	62	57	39	29	13.2	very gravelly SAND, brown (SM)
CN-T-10 #2 @ 3.1' - 9.2'	1.0	-	-	100	-	77	-	-	55	47	41	32	26	12	7	3.5	sandy GRAVEL, light brown (GP)
CN-T-10 #3 @ 9.2' - 11'	2.6	-	-	-	-	100	-	-	87	85	81	64	33	10	7	3.4	very gravelly SAND, light brown (SP)
CN-T-11 #1 @ 0'- 5.2'	7.1	21	NP	-	-	100	-	-	97	93	88	83	79	73	63	34.5	very silty SAND, brown (SM)
CN-T-11 #2 @ 5.2' - 9.5'	2.9	-	-	-	-	100	-	-	91	73	68	58	50	21	5	1.3	very gravelly SAND, light brown (SP)
CN-T-12 #1 @ 0' - 6.1'	3.6	-	-	-	-	100	-	-	79	71	62	47	35	14	6	3.4	very sandy GRAVEL, light brown (GP)
CN-T-13 #1 @ 0'- 5.4'	0.7	-	-	100	-	90	-	-	66	57	51	39	27	9	4	1.7	very sandy GRAVEL, light brown (GP)
CN-T-13 #2 @ 5.4' - 9.1'	7.0	-	-	-	-	100	-	-	72	64	58	42	32	16	11	7.2	very sandy GRAVEL, light brown (GP-GM)

WESTERN TECHNOLOGIES INC.

8305 Washington Place, N.E.
Albuquerque, New Mexico 87113
(505) 823-4488

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013
Lab/Invoice No. 3227W040
Date of Report
Reviewed By

Project Army Corps of Engineers
Location CN-T-14 Sampled By Corps Date N/A
Type of Aggregate Silty Gravelly Sand (SP-SM) Submitted By Corps Date 4/87
Source of Aggregate Hole #1 @ 2' Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"	100	
¾"	94	
½"	75	
⅜"	70	
¼"	62	
No. 4	57	
8	48	
10	42	
16	35	
30	30	
40	24	
50	13	
100	11	
200	8	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		* | N.P.	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318

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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report

Reviewed By

Project Army Corps of Engineers

Location CN-T-14 Sampled By Corps Date N/A

Type of Aggregate Silty Gravelly Sand (SP-SM) Submitted By Corps Date 4/87

Source of Aggregate Hole #2 @ 4' - 6' Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"	100	
1¼"		
1"	92	
¾"	85	
½"	70	
⅜"	64	
¼"	56	
No. 4	52	
8	42	
10	41	
16	37	
30	34	
40	31	
50	26	
100	15	
200	9	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		* | N.P.	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318

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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013
Lab/Invoice No. 3227W040
Date of Report
Reviewed By

Project Army Corps of Engineers
Location CN-T-15 Sampled By Corps Date N/A
Type of Aggregate Sandy Clay (CL) Submitted By Corps Date 4/87
Source of Aggregate Hole #1 Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"		
¾"		
½"		
⅜"		
¼"		
No. 4	100	
8	99	
10	99	
16	99	
30	98	
40	98	
50	97	
100	90	
200	77	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		44 | 28	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

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LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013
Lab/Invoice No. 3227W040
Date of Report
Reviewed By

Project Army Corps of Engineers
Location CN-T-16 Sampled By Corps Date N/A
Type of Aggregate Gravelly Clayey Sand(SP-SC) Submitted By Corps Date 4/87
Source of Aggregate Hole #1 @ 1.5' Authorized By Date

Sieve Analysis, ASTM C136- Test Standards are ASTM unless otherwise noted.

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"	100	
¾"	91	
½"	87	
⅜"	76	
¼"	64	
No. 4	57	
8	42	
10	41	
16	34	
30	28	
40	26	
50	24	
100	16	
200	10	
Finer than 200 ASTM C117-		

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131- Grading
	% Wear, 500 rev.			
	% Wear, rev.			C535- Grading
	% Wear, 1000 rev.			
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		25 | 16	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

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PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report

Reviewed By

Project Army Corps of Engineers

Location CN-T-16 Sampled By Corps Date N/A

Type of Aggregate Silty Clayey Sand (SC-SM) Submitted By Corps Date 4/87

Source of Aggregate Hole #2 @ 4' Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"		
¾"		
½"		
⅜"		
¼"		
No. 4		
8		
10	100	
16	99	
30	99	
40	98	
50	94	
100	73	
200	46	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		20 | 6	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

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PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report

Reviewed By

Project Army Corps of Engineers

Location CN-T-17 Sampled By Corps Date N/A

Type of Aggregate Silty Gravelly Sand (SM) Submitted By Corps Date 4/87

Source of Aggregate Hole #1 Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"		
¾"	100	
½"	90	
⅜"	88	
¼"	86	
No. 4	83	
8	79	
10	79	
16	76	
30	69	
40	61	
50	52	
100	33	
200	21	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		* | N.P.	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318

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(505) 823-4488

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013
Lab/Invoice No. 3227W040
Date of Report
Reviewed By

Project Army Corps of Engineers
Location CN-T-18 Sampled By Corps Date N/A
Type of Aggregate Clayey Sand (SC) Submitted By Corps Date 4/87
Source of Aggregate Hole #1 Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"		
¾"		
½"		
⅜"		
¼"		
No. 4		
8	99	
10	99	
16	98	
30	91	
40	76	
50	58	
100	31	
200	17	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131- Grading
	% Wear, 500 rev.			
	% Wear, rev.			C535- Grading
	% Wear, 1000 rev.			
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		46 | 15	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

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8305 Washington Place, N.E.
Albuquerque, New Mexico 87113
(505) 823-4488

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013
Lab/Invoice No. 3227W040
Date of Report
Reviewed By

Project Army Corps of Engineers
Location CN-T-19 Sampled By Corps Date N/A
Type of Aggregate Sandy Gravel (GP) Submitted By Corps Date 4/87
Source of Aggregate Hole #1 @ Surface Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"	100	
1¼"		
1"	86	
¾"	74	
½"	64	
⅜"	57	
¼"	49	
No. 4	45	
8	37	
10	36	
16	29	
30	16	
40	9	
50	5	
100	2	
200	1	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		* | N.P.	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

*Liquid Limit was not determined in accordance with ASTMD 4318

WESTERN TECHNOLOGIES INC.

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Albuquerque, New Mexico 87113
(505) 823-4488

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report

Reviewed By

Project Army Corps of Engineers

Location CN-T-19 Sampled By Corps Date N/A

Type of Aggregate Gravelly Sand (SP) Submitted By Corps Date 4/87

Source of Aggregate Hole #2 @ 2' Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"		
¾"	100	
½"	87	
⅜"	85	
¼"	82	
No. 4	80	
8	75	
10	74	
16	66	
30	44	
40	29	
50	16	
100	5	
200	3	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		* | N.P.	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318

WESTERN TECHNOLOGIES INC.

8305 Washington Place, N.E.
Albuquerque, New Mexico 87113
(505) 823-4488

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013

Lab/Invoice No. 3227W040

Date of Report

Reviewed By

Project Army Corps of Engineers

Location CN-T-20 Sampled By Corps Date N/A

Type of Aggregate Gravelly Sand (SP) Submitted By Corps Date 4/87

Source of Aggregate Hole #1 @ Surface Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"		
1¼"		
1"	100	
¾"	91	
½"	83	
⅜"	71	
¼"		
No. 4	53	
8	41	
10	39	
16	33	
30	16	
40	10	
50	5	
100	1	
200	0	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131- Grading
	% Wear, 500 rev.			
	% Wear, rev.			C535- Grading
	% Wear, 1000 rev.			
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		* | N.P.	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318

WESTERN TECHNOLOGIES INC.

8305 Washington Place, N.E.
Albuquerque, New Mexico 87113
(505) 823-4488

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client

Job No. 3227J013
Lab/Invoice No. 3227W040
Date of Report
Reviewed By

Project Army Corps of Engineers
Location CN-T-20 Sampled By Corps Date N/A
Type of Aggregate Sandy Gravel (GP) Submitted By Corps Date 4/87
Source of Aggregate Hole #2 @ 2.5' Authorized By Date

Sieve Analysis, ASTM C136-

Sieve Size	% Passing Accumulative	Specification
4"		
3"		
2"		
1½"	100	
1¼"		
1"	79	
¾"	72	
½"	67	
⅜"	59	
¼"	53	
No. 4	48	
8	37	
10	35	
16	27	
30	15	
40	9	
50	5	
100	1	
200	0	
Finer than 200 ASTM C117-		

Test Standards are ASTM unless otherwise noted.

Test		Result	Specification	Test STD
Fineness Modulus				C125-
Dry Rodded Unit Weight, pcf				C29-
Lightweight Pieces, %				C123-
Clay Lumps and Friable Particles				C142-
Organic Impurities				C40-
Sand Equivalent Value				C2419-
Resistance to Abrasion	% Wear, rev.			C131-
	% Wear, 500 rev.			Grading
	% Wear, rev.			C535-
	% Wear, 1000 rev.			Grading
Scratch Hardness, % by: Weight | Count		|	|	C235-
Fractured Faces, % by: Weight | Count		|	|	
Liquid Limit | Plasticity Index		* | N.P.	|	D4318-
Cleanness Value				Calif. 227-
Moisture Density Relations	Max. Dry Density, pcf		☐ D698- ☐ D1557- ☐ AASHTO T99- ☐ AASHTO T180-	
	Optimum Moisture, %			
	Method			
Specific Gravity	Absorption, %		☐ C127- ☐ C128-	
	Bulk (Dry)			
	Bulk (SSD)			
	Apparent			

Copies to:

*Liquid Limit was not determined in accordance with ASTM D4318

Test Results for Left Abutment Foundation Material

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 15292 (30 pages)

PROJECT: CUCHILLO NEGRO DAM Feature: LEFT ABUTMENT	Contract No.
TEST REQUEST NO.: E86910020 * Dated: 15 JAN 1991 Received: 17 JAN 1991	From: CHIEF ENG/PLNG DIVISION ALBUQUERQUE DISTRICT

MATERIAL: DISTURBED AND UNDISTURBED SOIL SAMPLES
No. and type of samples: 7 RECORD SAMPLES, 1 BAG AND 3 CTNS.
Source or other identification: JOINT FILLING, SHEAR/BRECCIA ZONE LEFT ABUTMENT

* CHANGE ORDER NUMBER 1
DATED: 03 MAR 1991.
RECEIVED: 15 APRIL 1991.

Date received: 12 AND 24 JAN 1991.

REMARKS: ALL TESTS HAVE BEEN PERFORMED IN ACCORDANCE WITH EM 1110-2-1906. SAMPLES WITH GRAIN SIZE DISTRIBUTION AND ATTERBERG LIMITS TESTS HAVE BEEN CLASSIFIED IN ACCORDANCE WITH MIL STD. 619B. ALL OTHER SAMPLES HAVE BEEN VISUALLY CLASSIFIED ONLY.

RESULTS OF TESTS	TABLE 1
PLASTICITY CHART	PLATE 1
GRAIN SIZE DISTRIBUTION CURVES W/HYDROMETER	PLATES 2-12
RESIDUAL DIRECT SHEAR TESTS	PLATES 13-16
CONSOLIDATION TESTS	PLATES 17-28

Report sent to:	Copy furnished:
ALBUQUERQUE DISTRICT	

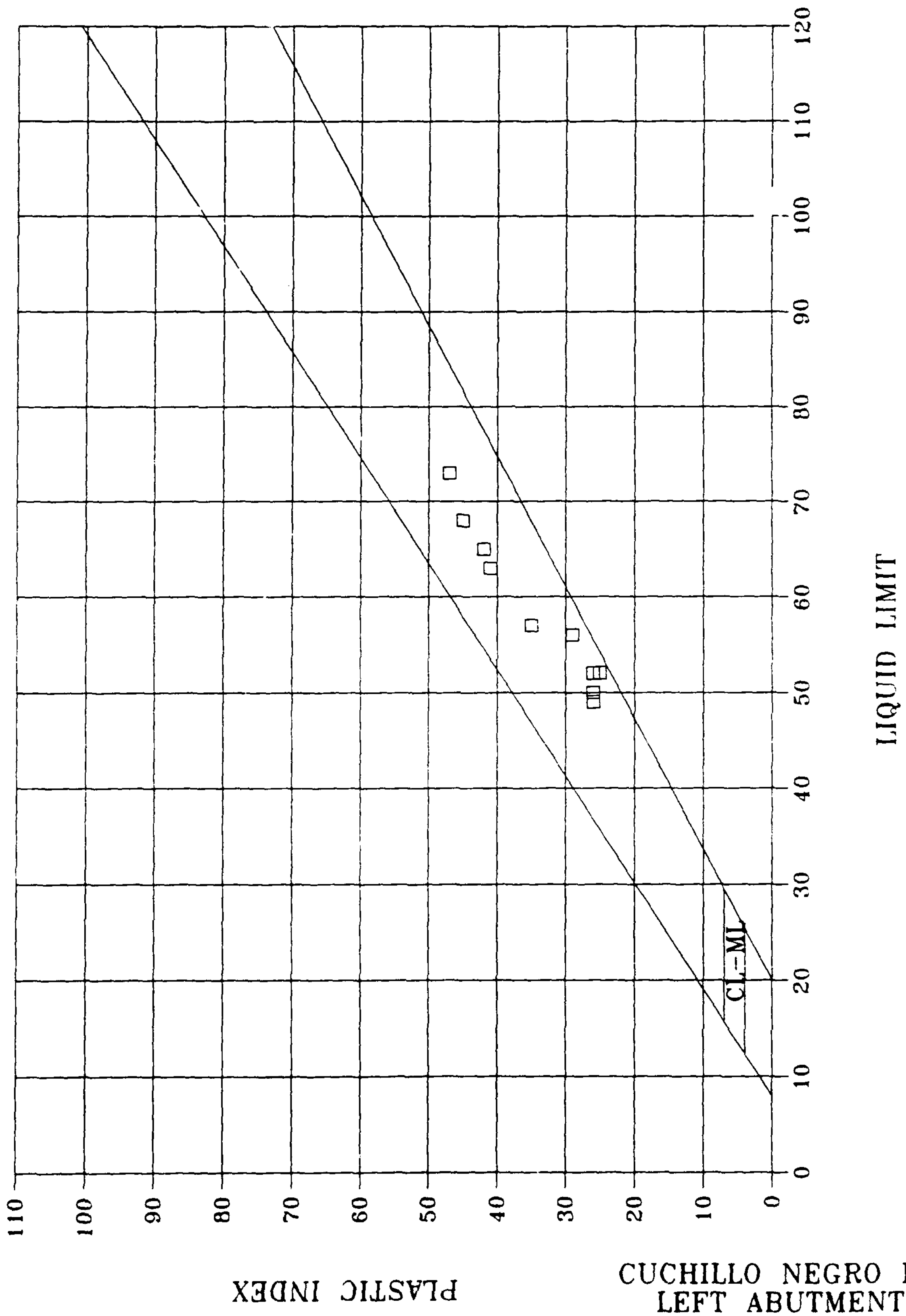
Date:	Name and title:	Signature
16 April 1991	WILLIAM R. TANNER Director SWD Laboratory	William R. Tanner

TABLE 1

RESULTS OF TESTS OF DISTURBED AND UNDISTURBED SOIL SAMPLES

SWDED-GL REPORT NO. 15292 CUCHILLO NEGRO - LEFT ABUTMENT

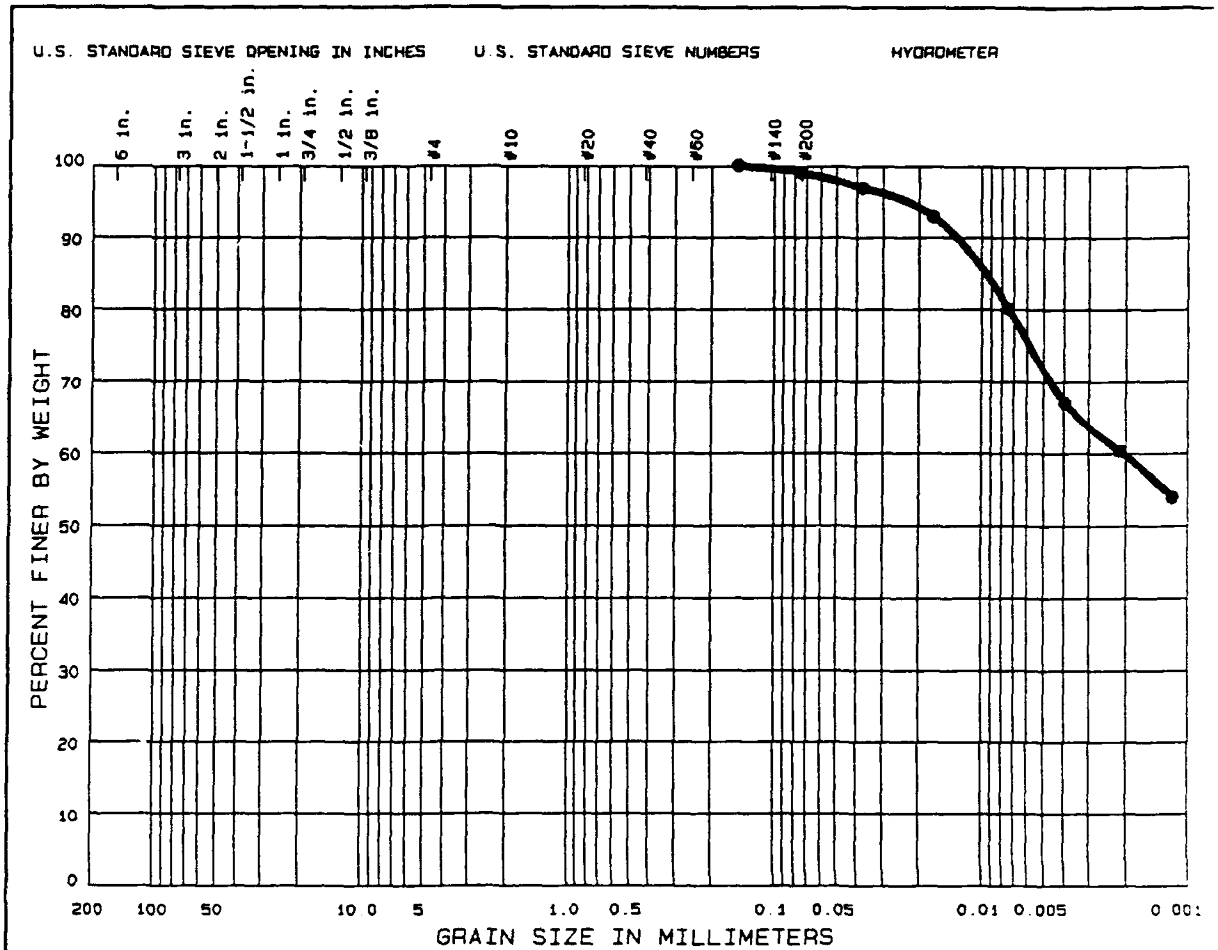
BORING NO.	SWB NO.	FLD NO.	DEPTH, FT	GR	SA	FI	LL	PL	PI	LS	WC, %	PCF	MAJOR TESTS	DESCRIPTION OF MATERIAL
JOINT FILLING 91/	1	BAG-1	4650 -	0	1	99	73	25	47		37.7			- SHALE, BROWN TO LIGHT GRAY, MOIST, CALCAREOUS.
SHE/BRECCIA ZONE 91/	2	CTN-2	4640 -	2	1	97	56	27	29		18.6			- SHALE, PINK WITH YELLOW AND DARK REDDISH BROWN, HARD, CALCAREOUS, CALCAREOUS NODULES.
1+350+1+600,L.ABT91/	3	CTN-3	4625 -4630	0	3	97	65	23	42		19.8			CH - FAT CLAY, YELLOW TO DARK BROWN, POSSIBLY HIGHLY WEATHERED SHALE, MOIST, SLIGHTLY CALCAREOUS, SCATTERED GRAVEL TO 2".
2+700,LT.ABUTMENT91/	4	CTN-4	4670 -	0	4	96	68	23	45		14.6			CH - FAT CLAY, REDDISH BROWN, POSSIBLY HIGHLY WEATHERED SHALE, MOIST, SLIGHTLY CALCAREOUS, SCATTERED GRAVEL TO 1 1/2".
1+350, LT. ABT 91/	5	CYL	4640 -	0	1	99	49	23	26		11.1		CONSOL, RES. DS	- SHALE, LIGHT OLIVE BROWN WITH DARK REDDISH BROWN, MOIST, CALCAREOUS.
1+350, LT. ABT 91/	6	CYL	4640 -	0	0	100	52	26	26		13.5			- SHALE, GRAYISH BROWN WITH YELLOWISH RED, MOIST, CALCAREOUS.
1+350, LT. ABT 91/	7	CYL	4640 -	0	1	99	52	27	25		12.5		CONSOL	- SHALE, GRAYISH BROWN WITH DARK REDDISH BROWN, MOIST, CALCAREOUS.
1+50P.C/L,LT ABT 91/	9	CYL	4635 -	0	2	98	50	24	26		8.8			CH - FAT CLAY, WHITE, POSSIBLE SHALE, DAMP, CALCAREOUS.
1+550, LT. ABUT 91/	9	CYL	4635 -	0	8	92	50	24	26		9.4		CONSOL, RES. DS	CH - FAT CLAY, WHITE, POSSIBLE SHALE, DAMP, CALCAREOUS.
1+600, LT. ABUT 91/	14	CYL	4635 -	2	6	92	63	22	41		19.2		RES. DS	- SHALE, GRAYISH BROWN WITH YELLOWISH RED, MOIST, CALCAREOUS.
1+600, LT. ABUT 91/	15	CYL	4630 -	0	2	98	57	22	35		13.2		CONSOL, RES. DS	- SHALE, GRAYISH BROWN WITH YELLOWISH RED, MOIST, CALCAREOUS.



CUCHILLO NEGRO DAM
LEFT ABUTMENT
PLASTICITY CHART
PLATE #

CESWD-ED-GL RPT NO. 15292

W.O. No.
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	1.0	99.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/1	4650.0'	37.7	73	27	46		

CLASSIFICATION

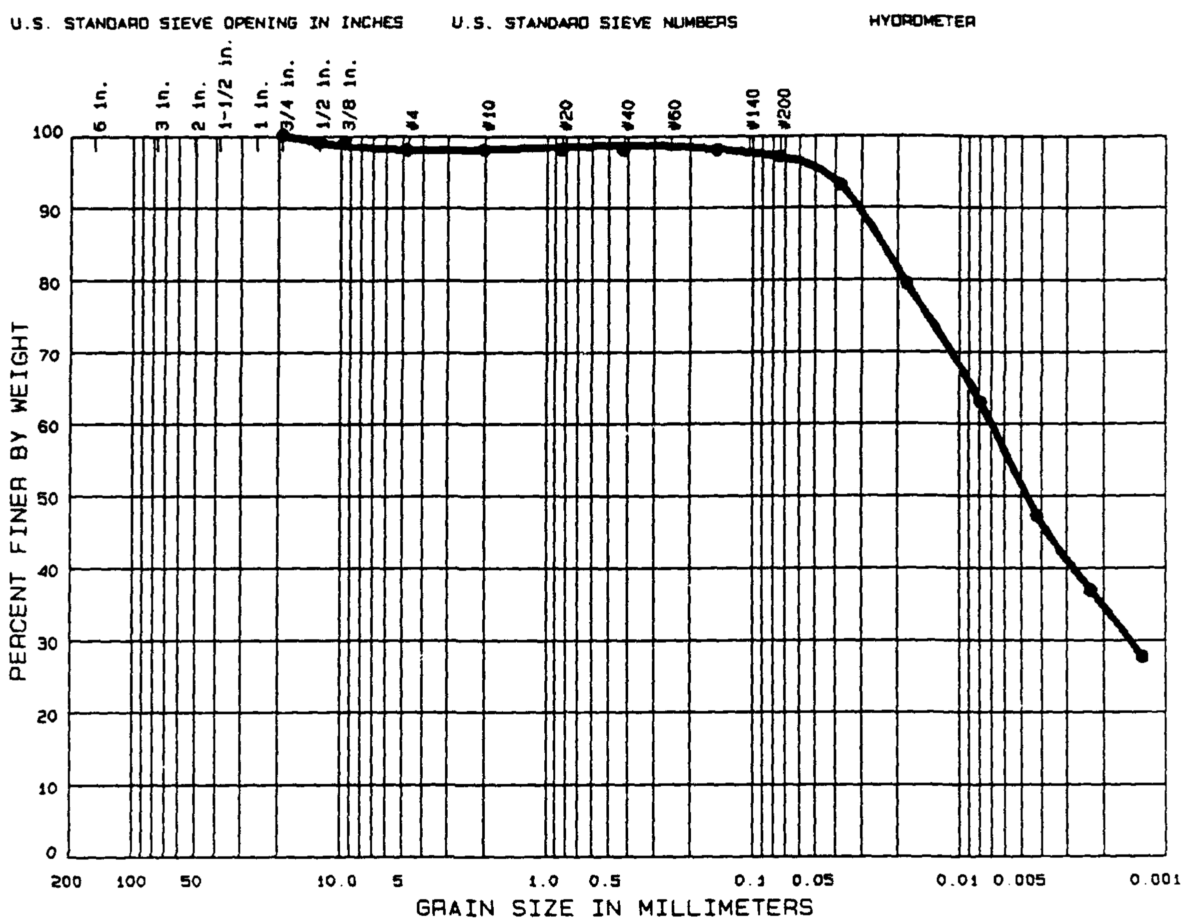
● SHALE

Remarks:	Project CUCHILLO NEGRO DAM LEFT ABUTMENT Lab No. CESWD-ED-GL RPT NO. 15292 Area Boring No JOINT FILLNG Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
● 0.0	2.0	1.0	97.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/2	4640.0'	18.6	56	27	29		

CLASSIFICATION

● SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15292

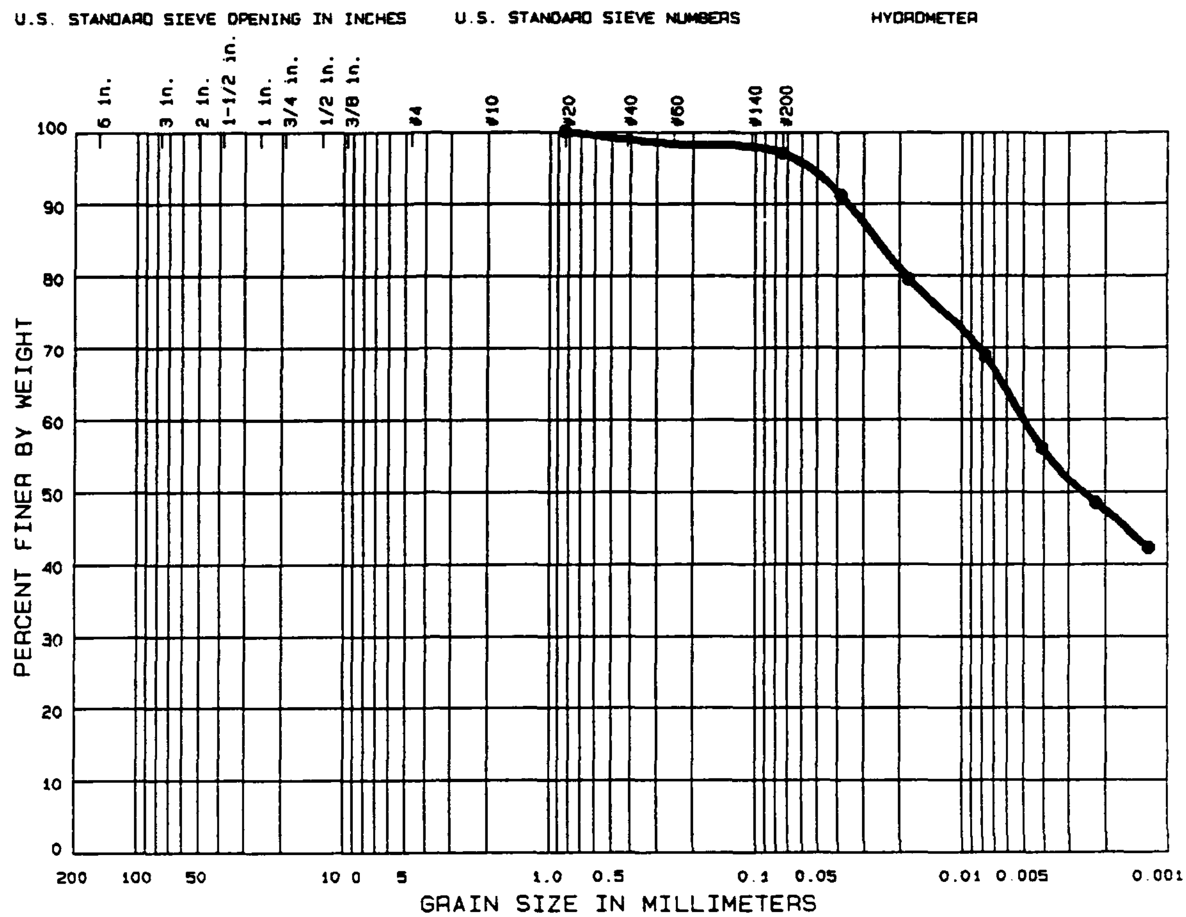
Area

Boring No SHEAR ZONE Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	3.0	97.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/3	4625-4630	19.8	65	23	42		

CLASSIFICATION

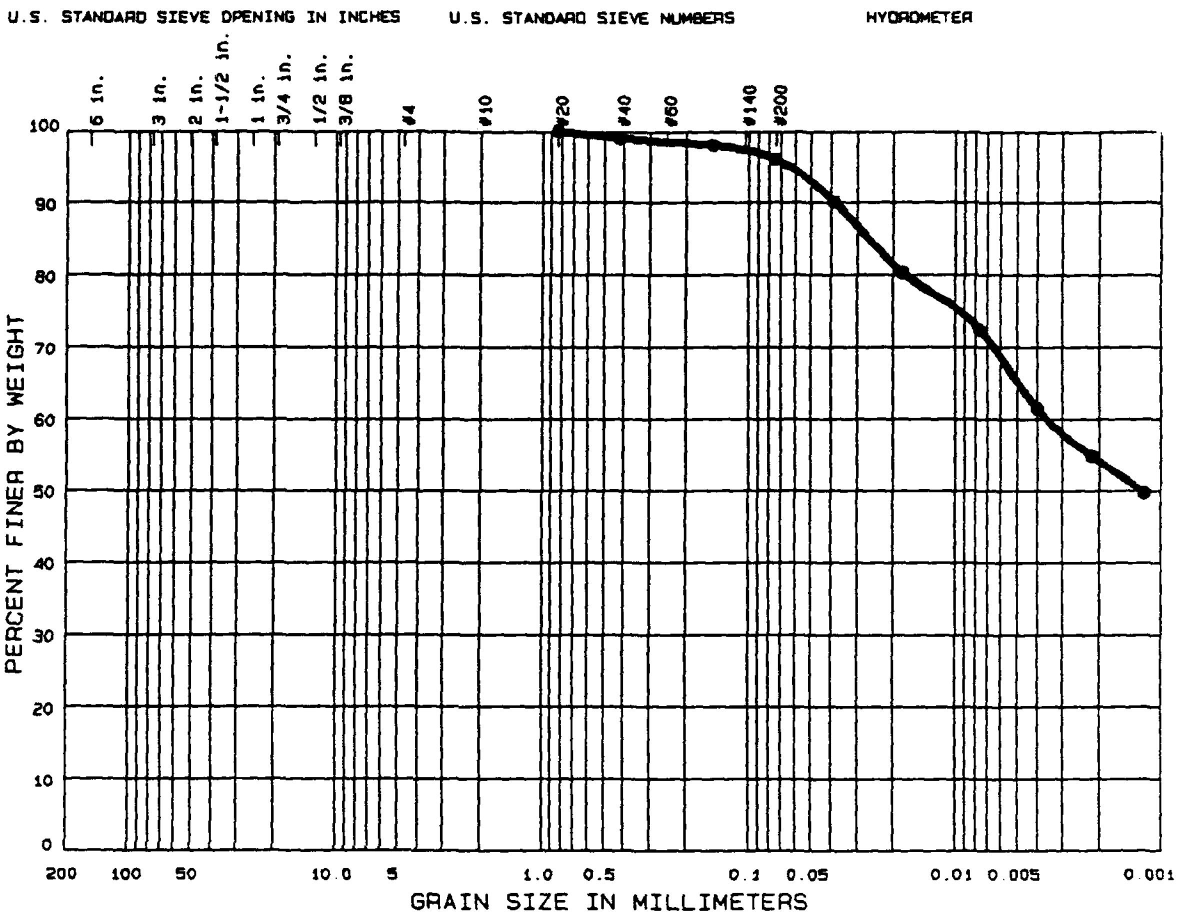
● FAT CLAY (CH), POSSIBLE SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15292
Area
Boring No 1+350+1+600 Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	4.0	96.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/4	4670'	14.6	68	23	45		

CLASSIFICATION

● FAT CLAY (CH), POSSIBLE SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15292

Area

Boring No. 2+700, LT AB Date FEB 1991

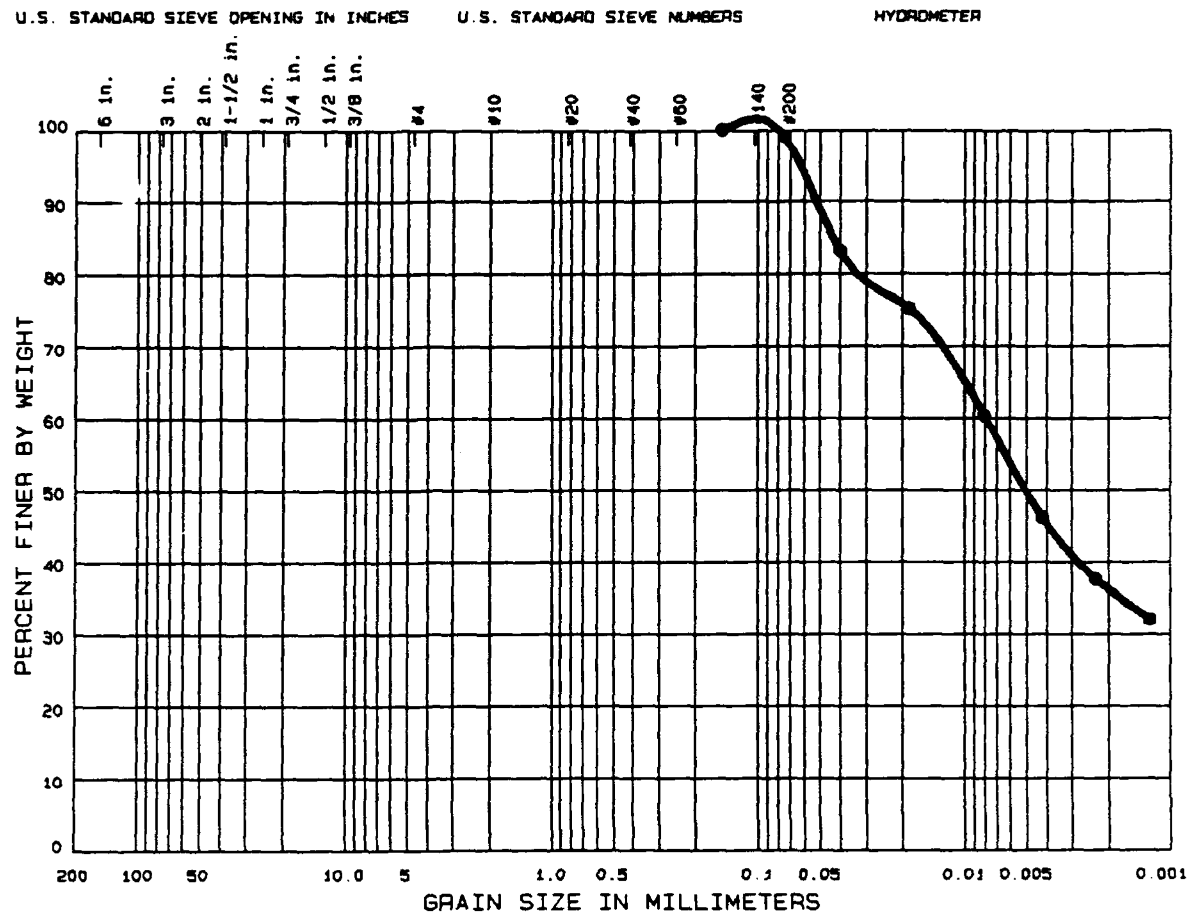
GRADATION CURVES

W.O. No.
Req. No.
Contract No.

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	1.0	99.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/5	4640	11.1	49	23	26		

CLASSIFICATION

● SHALE

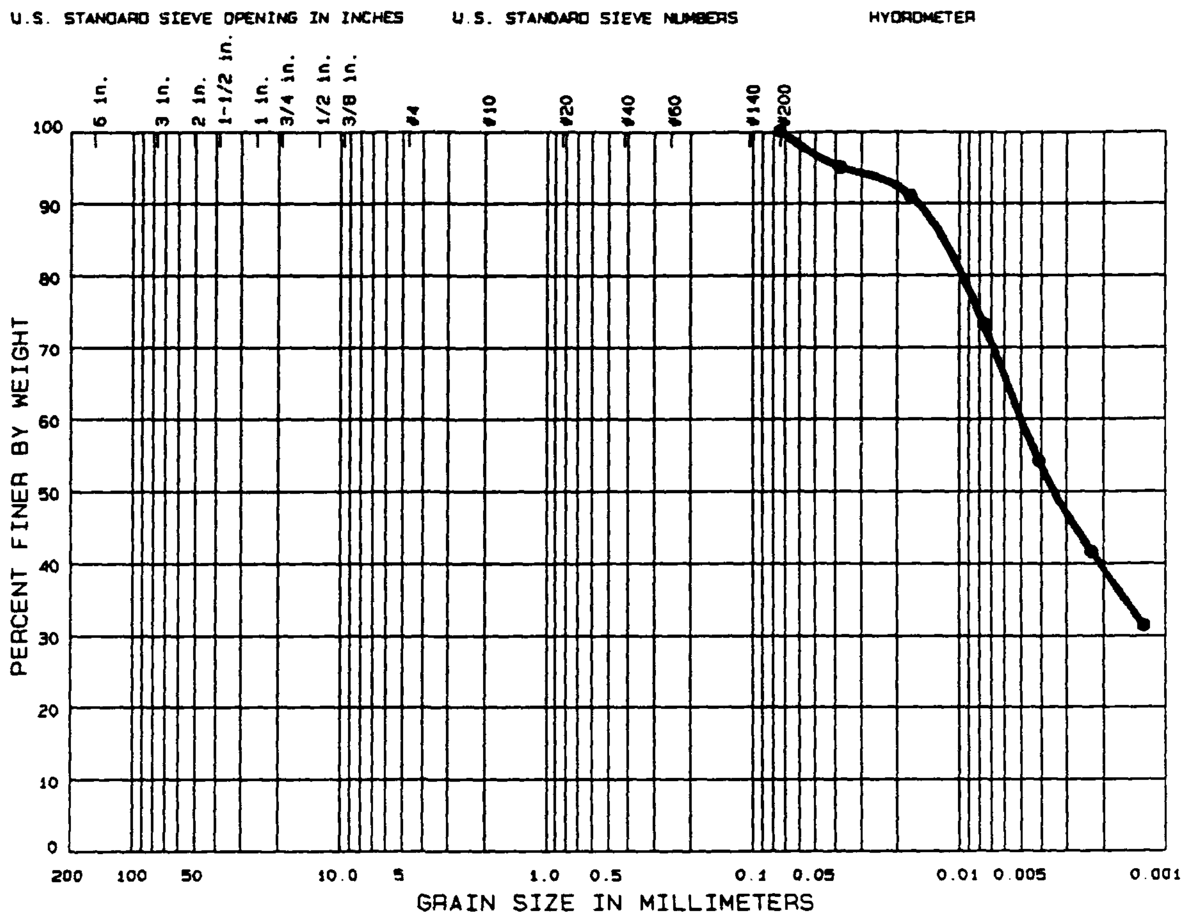
Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15292
Area
Boring No. 1+35D, LT AB Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



% COBBLES		% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	0.0	100.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/6	4640	13.5	52	26	26		

CLASSIFICATION

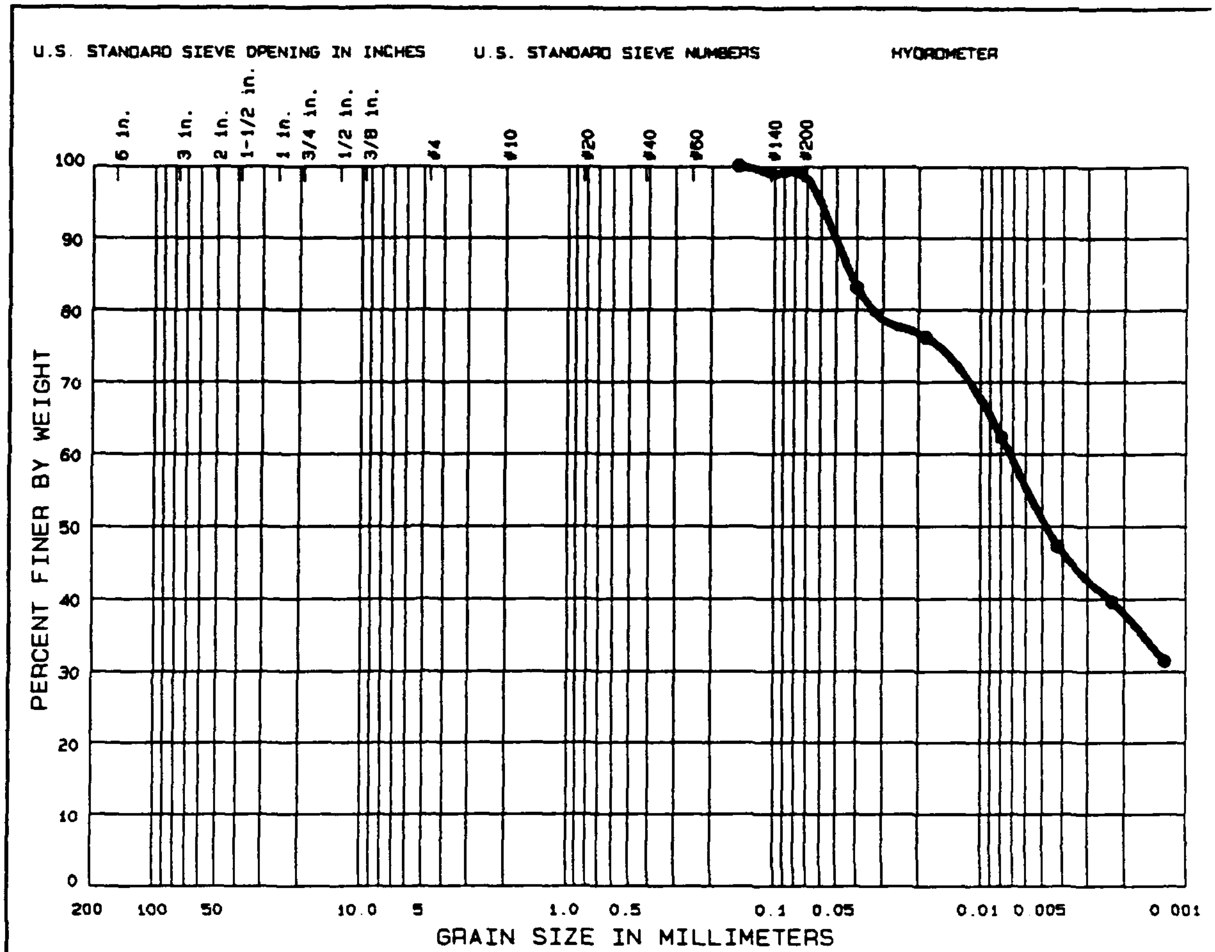
● SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15292
Area
Boring No 1+35D, LT AB Date FEB 1991

GRADATION CURVES

W.O. No.
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	1.0	99.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/7	4640	12.5	52	27	25		

CLASSIFICATION

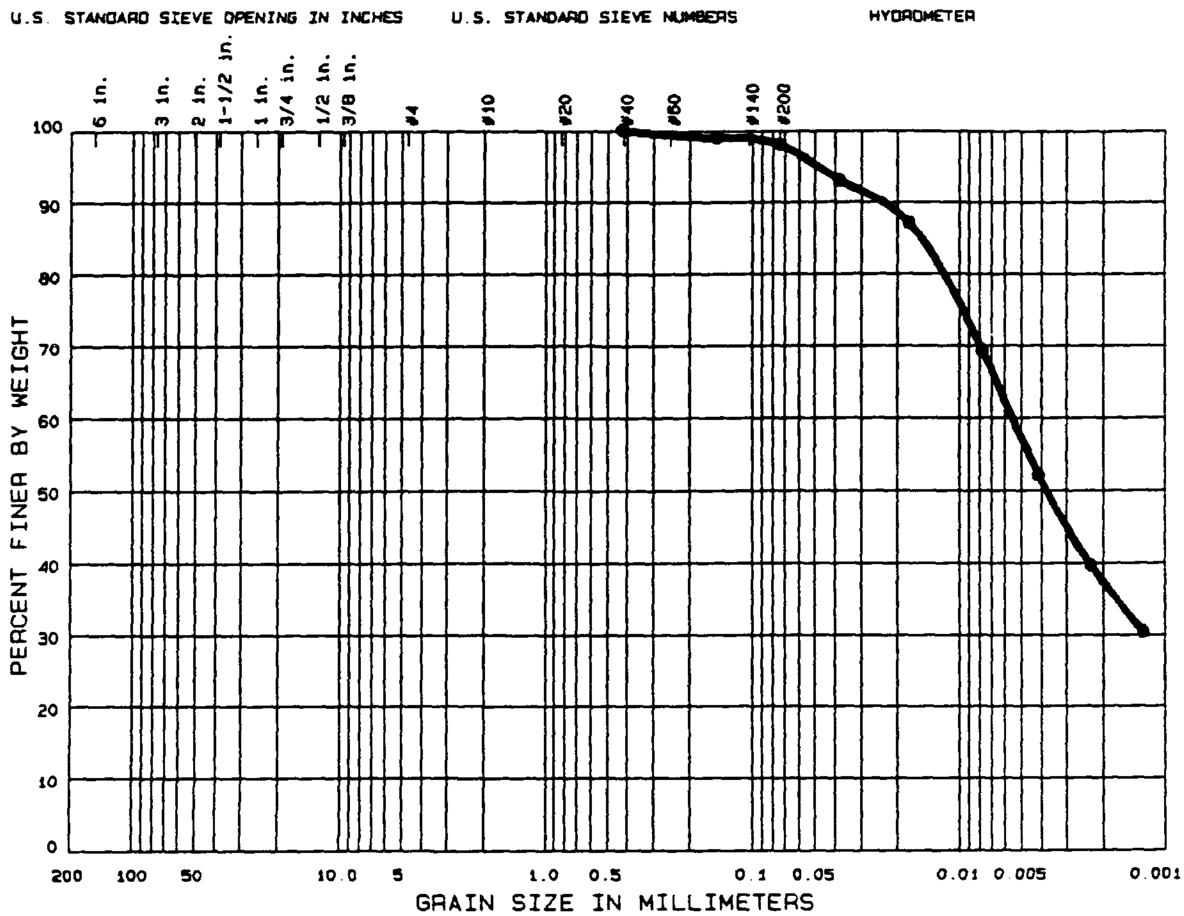
● SHALE

Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15292
Area
Boring No. 1+35D, LT AB Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235



% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
● 0.0	0.0	2 0	98.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/8	4635	8 8	50	24	26		

CLASSIFICATION

● FAT CLAY (CH), POSSIBLE SHALE

Remarks:

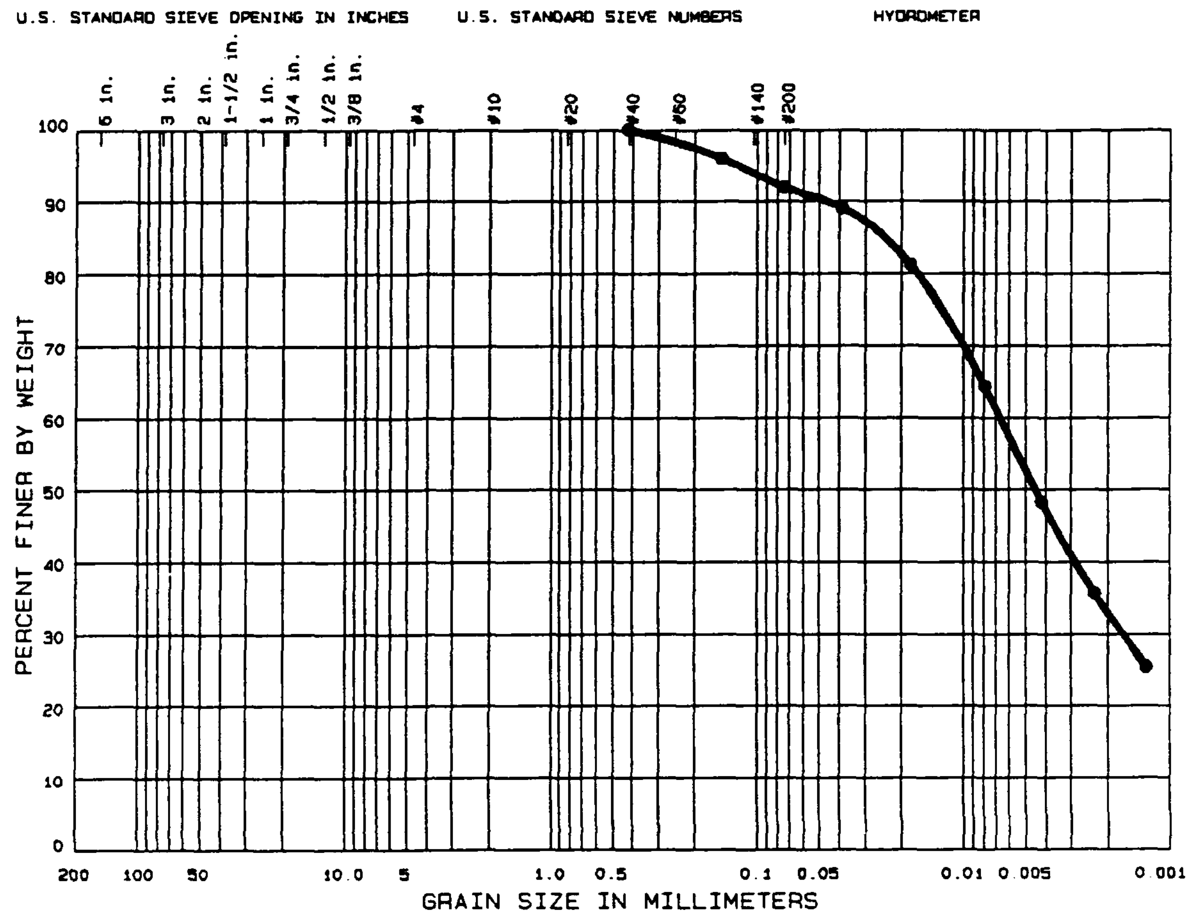
Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15292
Area
Boring No. 1+50D, CL, LTB Date FEB 1991

GRADATION CURVES

W.O. No.
Req. No.
Contract No.

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	8.0	92.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/9	4635	9.4	50	24	26		

CLASSIFICATION

● FAT CLAY (CH), POSSIBLE SHALE

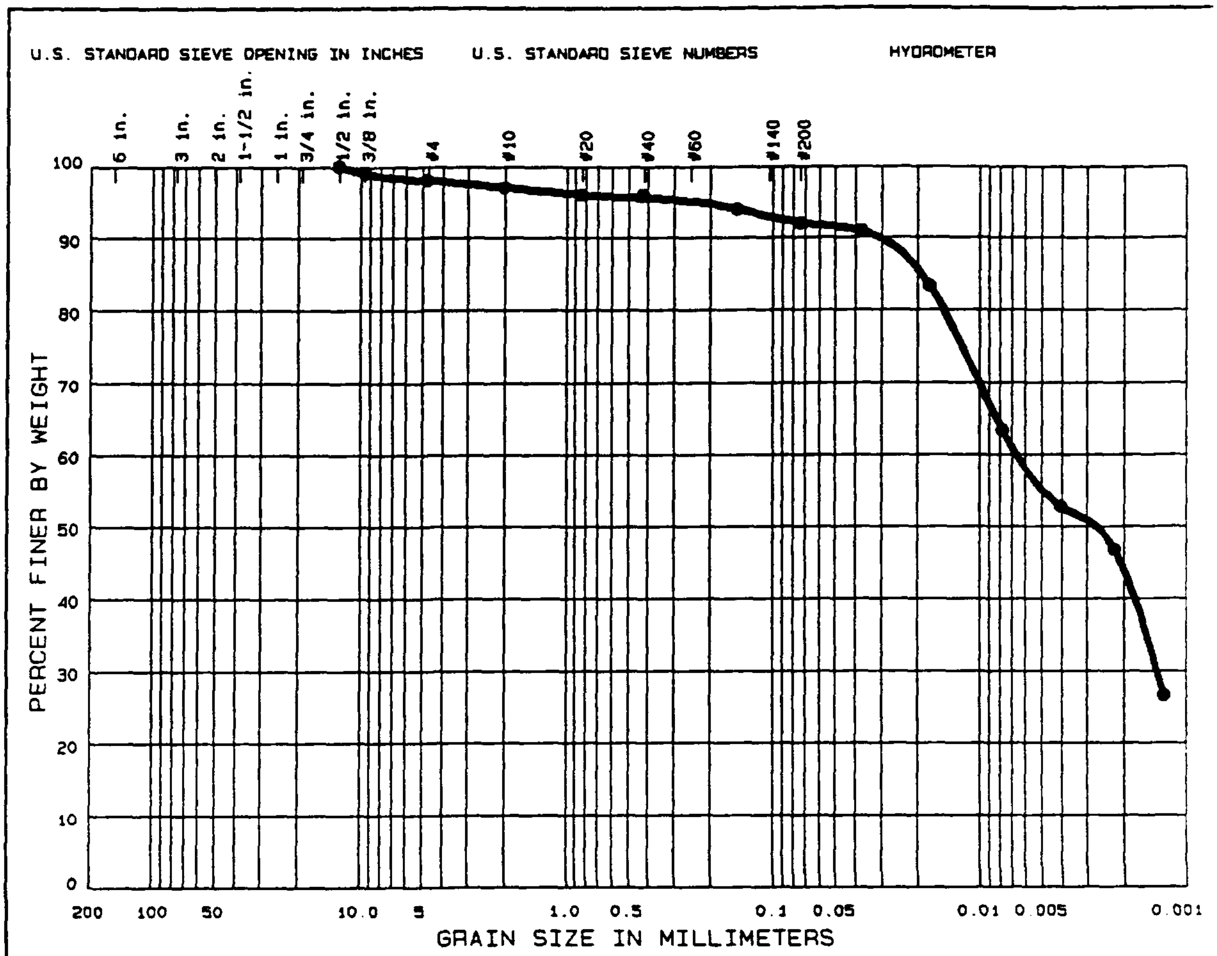
Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO 15292
Area
Boring No 1+550, LT AB Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	2.0	6.0	92.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/14	4635.0'	19.2	63	22	41		

CLASSIFICATION

● SHALE

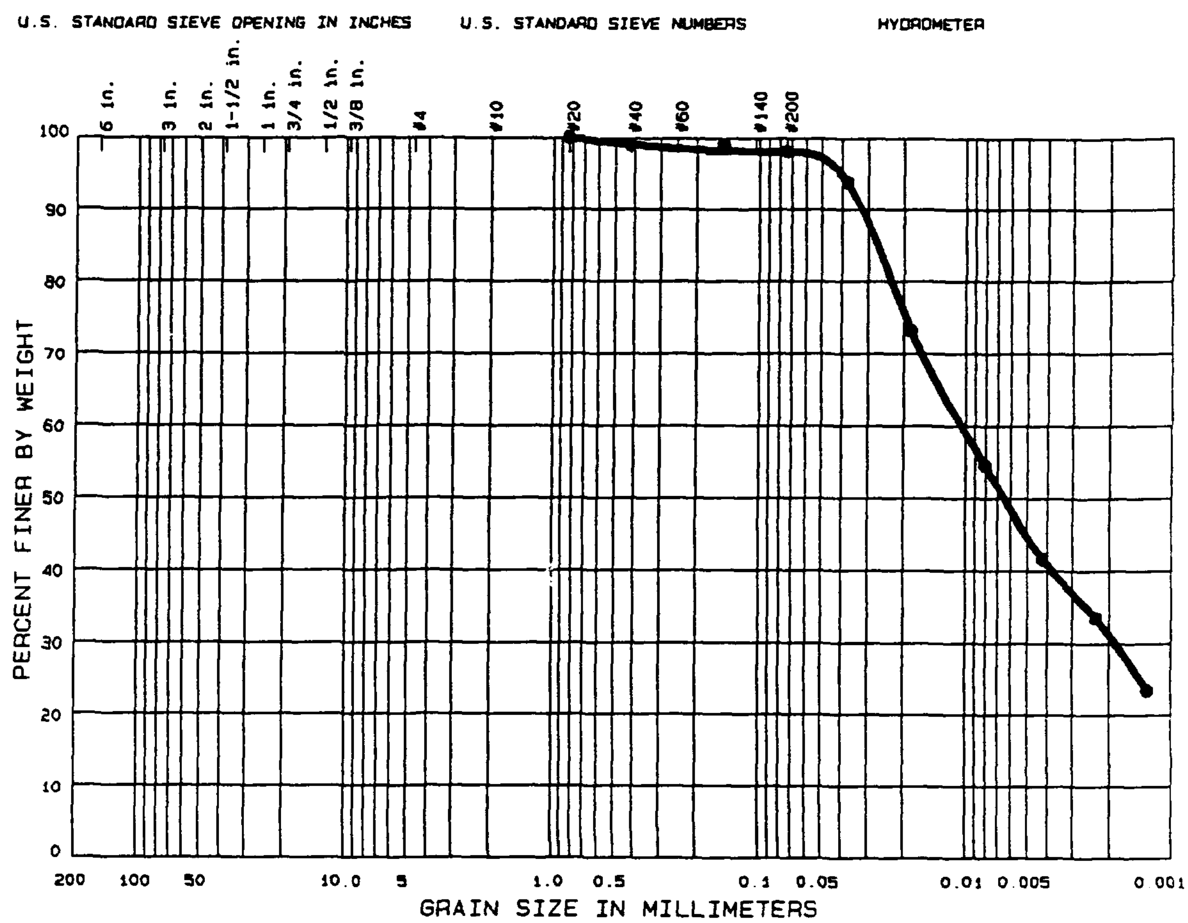
Remarks:

Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15293
Area
Boring No. STA 1+600 Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235

W.O. No.
Req. No.
Contract No.



	% COBBLES	% GRAVEL	% SAND	% SILT OR CLAY
●	0.0	0.0	2.0	98.0

	Sample No.	Elev or Depth	Nat W%	LL	PL	PI	C_c	C_u
●	91/15	4630.0'	13.2	57	22	35		

CLASSIFICATION

● SHALE

Remarks:

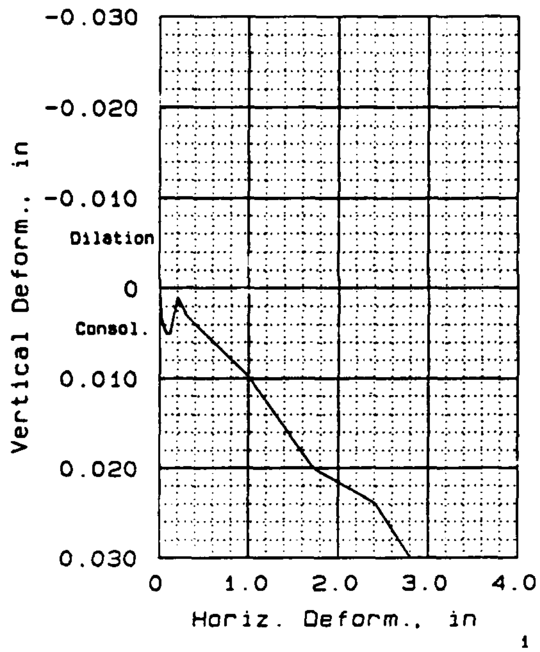
Project CUCHILLO NEGRO DAM
LEFT ABUTMENT
Lab No. CESWD-ED-GL RPT NO. 15293

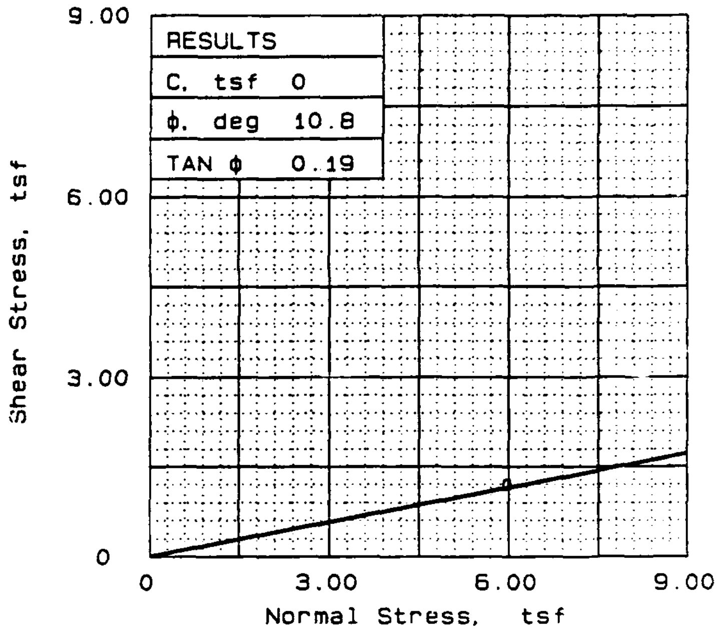
Area

Boring No. STA 1+600 Date FEB 1991

GRADATION CURVES

DEPARTMENT OF THE ARMY, SOUTHWESTERN DIVISION LABORATORY
CORPS OF ENGINEERS, 4815 CASS STREET, DALLAS, TX 75235





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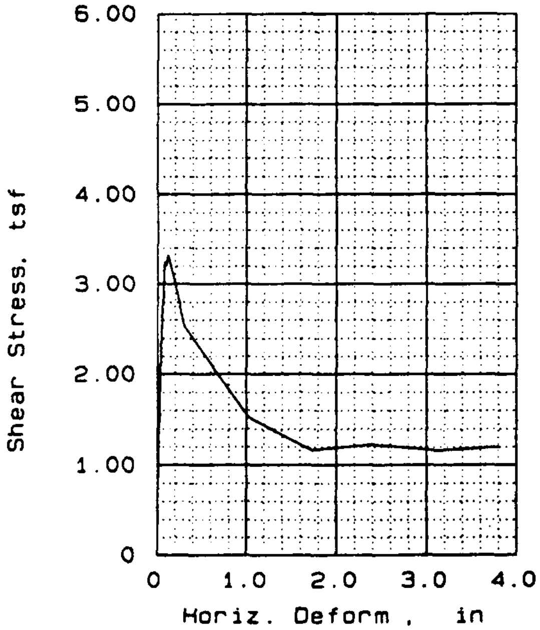


SAMPLE NO.		1
INITIAL	WATER CONTENT, %	11.0
	DRY DENSITY, pcf	119.0
	SATURATION, %	72.2
	VOID RATIO	0.412
	DIAMETER, in	2.51
	HEIGHT, in	1.00
AT TEST	WATER CONTENT, %	13.8
	DRY DENSITY, pcf	122.6
	SATURATION, %	100.7
	VOID RATIO	0.369
	DIAMETER, in	2.51
	HEIGHT, in	0.97
NORMAL STRESS, tsf		6.00
MAX. SHEAR, tsf		3.32
STRAIN RATE, %/min.		0.007
ULT. SHEAR, tsf		1.20

SAMPLE DATA

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: SHALE, HIGHLY FRACTURED

LL= 49 PL= 23 PI= 26.0

SPECIFIC GRAVITY= 2.69

REMARKS: SPECIFIC GRAVITY ESTIMATED

FIG. NO.

CLIENT: US ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT

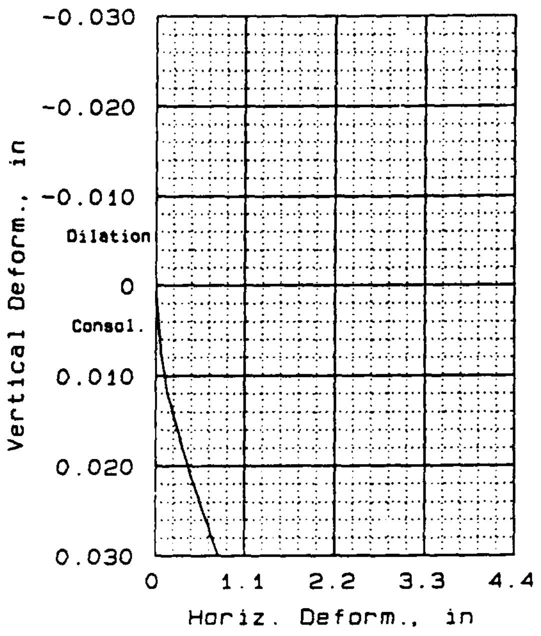
PROJECT: CUCHILLO DAM

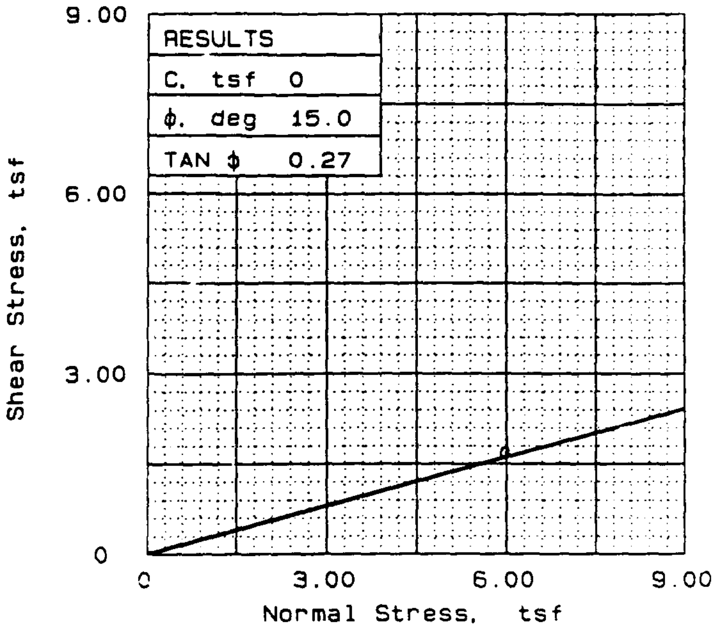
SAMPLE LOCATION: LEFT ABUTMENT, ELEV. 4640
1+35 D, SWD LAB NO. 90/5

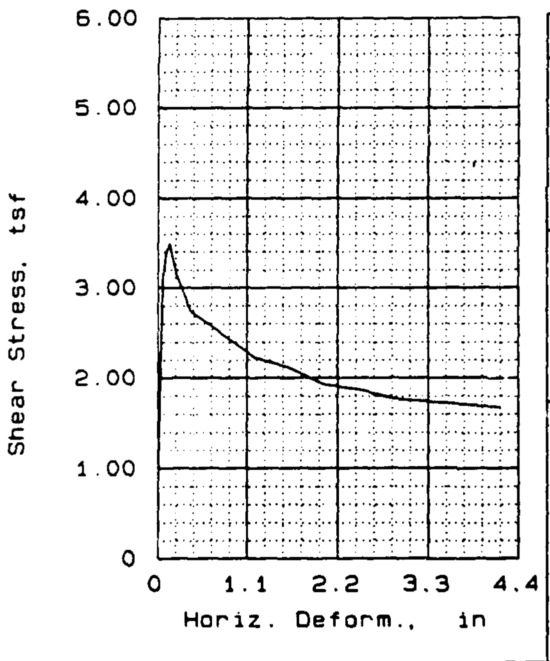
PROJ. NO.: 15292 DATE: JAN 1991

DIRECT SHEAR TEST

CORPS OF ENGINEERS - SOUTHWESTERN







	SAMPLE NO.	1
INITIAL	WATER CONTENT, %	9.4
	DRY DENSITY, pcf	105.2
	SATURATION, %	42.2
	VOID RATIO	0.597
	SIDE LENGTH, in	3.00
	HEIGHT, in	1.00
AT TEST	WATER CONTENT, %	19.8
	DRY DENSITY, pcf	109.5
	SATURATION, %	100.1
	VOID RATIO	0.533
	SIDE LENGTH, in	3.00
	HEIGHT, in	0.96
	NORMAL STRESS, tsf	6.00
	MAX. SHEAR, tsf	3.50
	STRAIN RATE, %/min.	0.007
	ULT. SHEAR, tsf	1.68

SAMPLE DATA 1

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: FAT CLAY (CH) POSSIBLE SHALE

LL= 50 PL= 24 PI= 26.0

SPECIFIC GRAVITY= 2.69

REMARKS: SPECIFIC GRAVITY ESTIMATED

FIG. NO.

CLIENT: US ARMY CORPS OF ENGINEERS ALBUQUERQUE DISTRICT

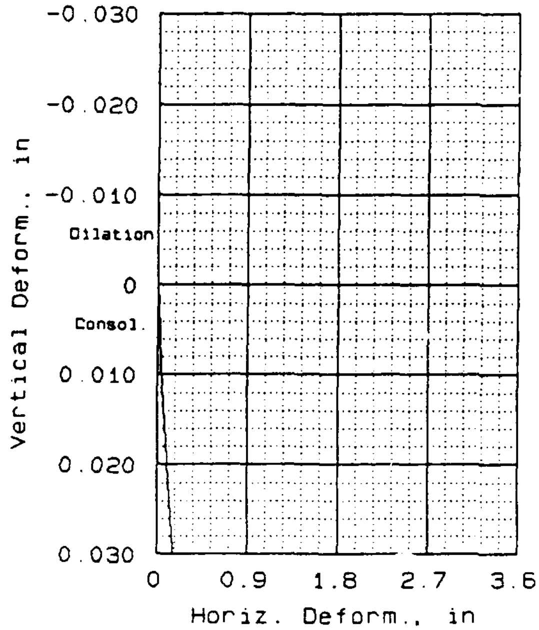
PROJECT: CUCHILLO DAM

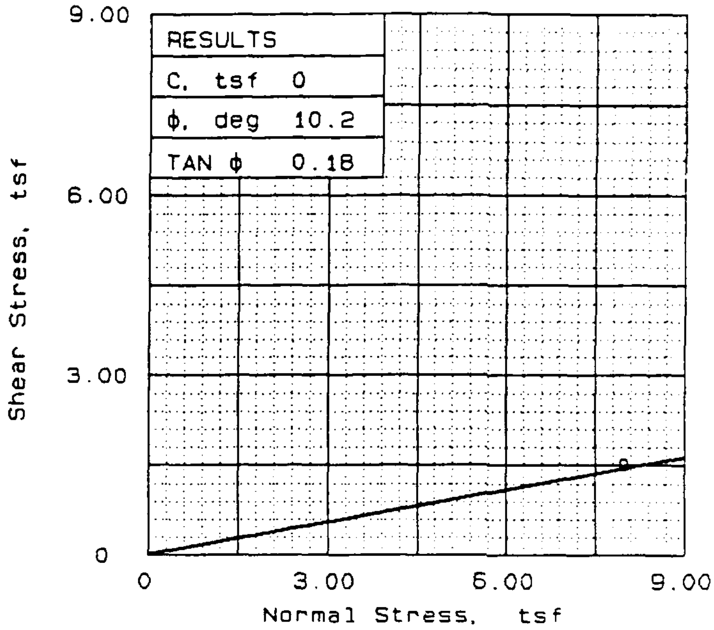
SAMPLE LOCATION: LEFT ABUTMENT, ELEV. 4635 1+55 D, SWD LASB NO. 90/9

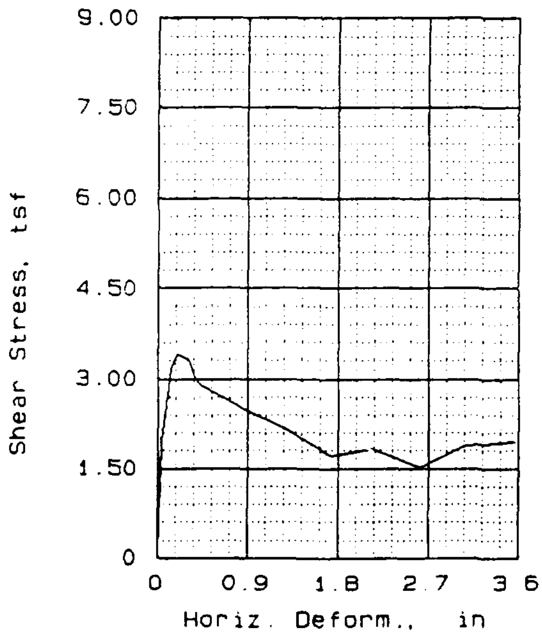
PROJ. NO.: 15292 DATE: JAN 1991

DIRECT SHEAR TEST

CORPS OF ENGINEERS - SOUTHWESTERN







SAMPLE NO.		1
INITIAL	WATER CONTENT, %	19.2
	DRY DENSITY, pcf	87 6
	SATURATION, %	56.2
	VOID RATIO	0.917
	SIDE LENGTH, in	3.00
	HEIGHT, in	1.00
AT TEST	WATER CONTENT, %	30.6
	DRY DENSITY, pcf	87.6
	SATURATION, %	89 8
	VOID RATIO	0.917
	SIDE LENGTH, in	3.39
	HEIGHT, in	1.00
NORMAL STRESS, tsf		8.00
MAX. SHEAR, tsf		3.38
STRAIN RATE, %/min.		0.002
ULT. SHEAR, tsf		1.52

SAMPLE DATA

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: SHALE

LL= PL= PI=

SPECIFIC GRAVITY= 2.69

REMARKS: SPECIFIC GRAVITY ESTIMATED
ULTIMATE SHEAR USED TO PLOT ϕ.

FIG NO

CLIENT: US ARMY CORPS OF ENGINEERS
ALBUQUREQUE DISTRICT

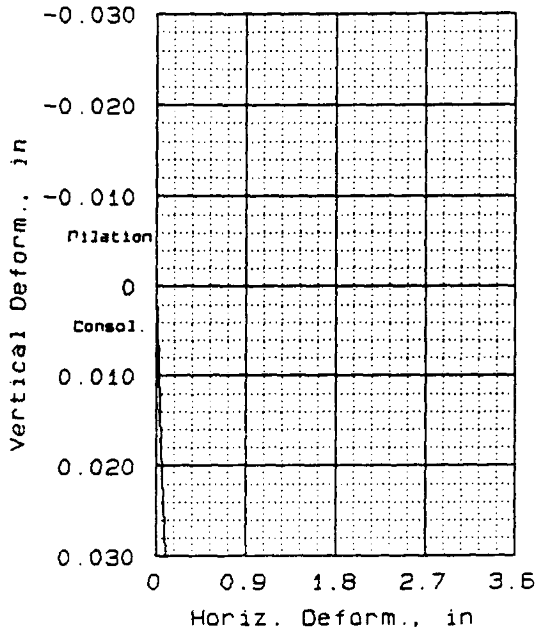
PROJECT: CUCHILLO DAM

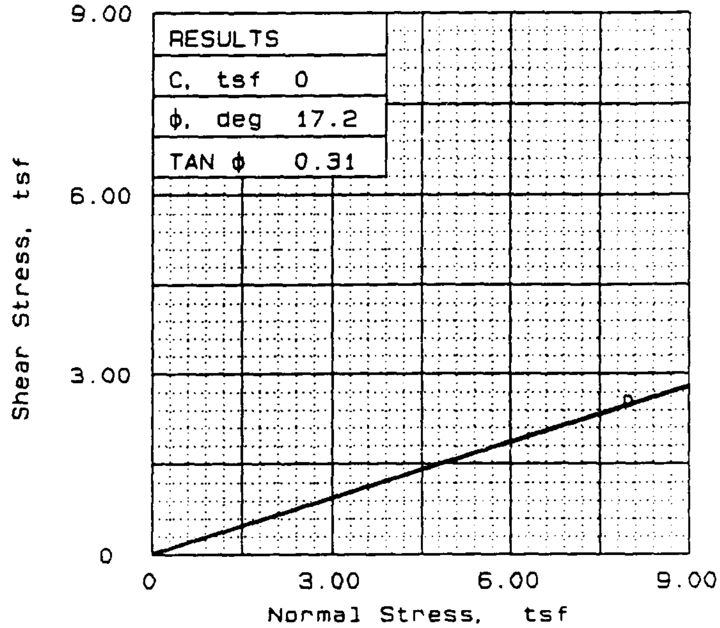
SAMPLE LOCATION: STA. 1+600, ELEV. 4635
SWD LAB NO. 91/14

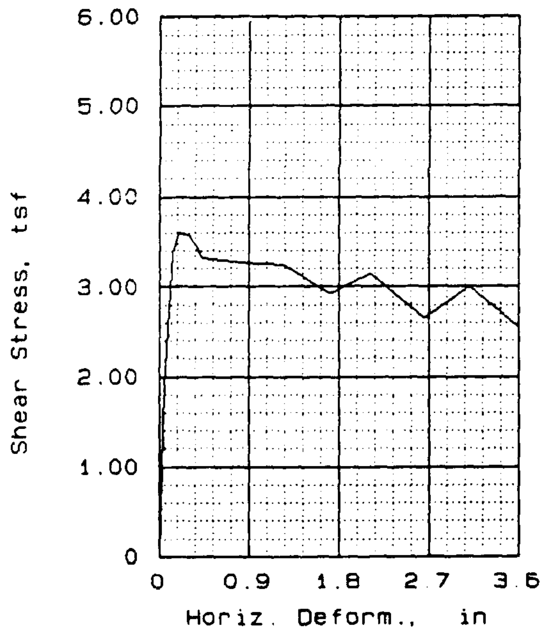
PROJ NO.: 15292 DATE: FEB 1991

DIRECT SHEAR TEST

CORPS OF ENGINEERS - SOUTHWESTERN







SAMPLE NO.		1
INITIAL	WATER CONTENT, %	10.7
	DRY DENSITY, pcf	77.0
	SATURATION, %	24.3
	VOID RATIO	1.181
	SIDE LENGTH, in	3.00
	HEIGHT, in	1.00
AT TEST	WATER CONTENT, %	31.8
	DRY DENSITY, pcf	84.1
	SATURATION, %	85.6
	VOID RATIO	0.998
	SIDE LENGTH, in	3.39
	HEIGHT, in	0.92
NORMAL STRESS, tsf		8.00
MAX. SHEAR, tsf		3.75
STRAIN RATE, %/min.		0.002
ULT. SHEAR, tsf		2.55

SAMPLE DATA

SAMPLE TYPE: UNDISTURBED

DESCRIPTION: SHALE

LL= PL= PI=

SPECIFIC GRAVITY= 2.69

REMARKS: SPECIFIC GRAVITY ESTIMATED
ULTIMATE SHEAR USED TO PLOT ϕ.
SAMPLE DID NOT SHEAR ALONG HORIZONTAL PLANE, THIS CAUSED LOAD TO CYCLE FROM HIGH TO LOW.

FIG. NO.

CLIENT: US ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT

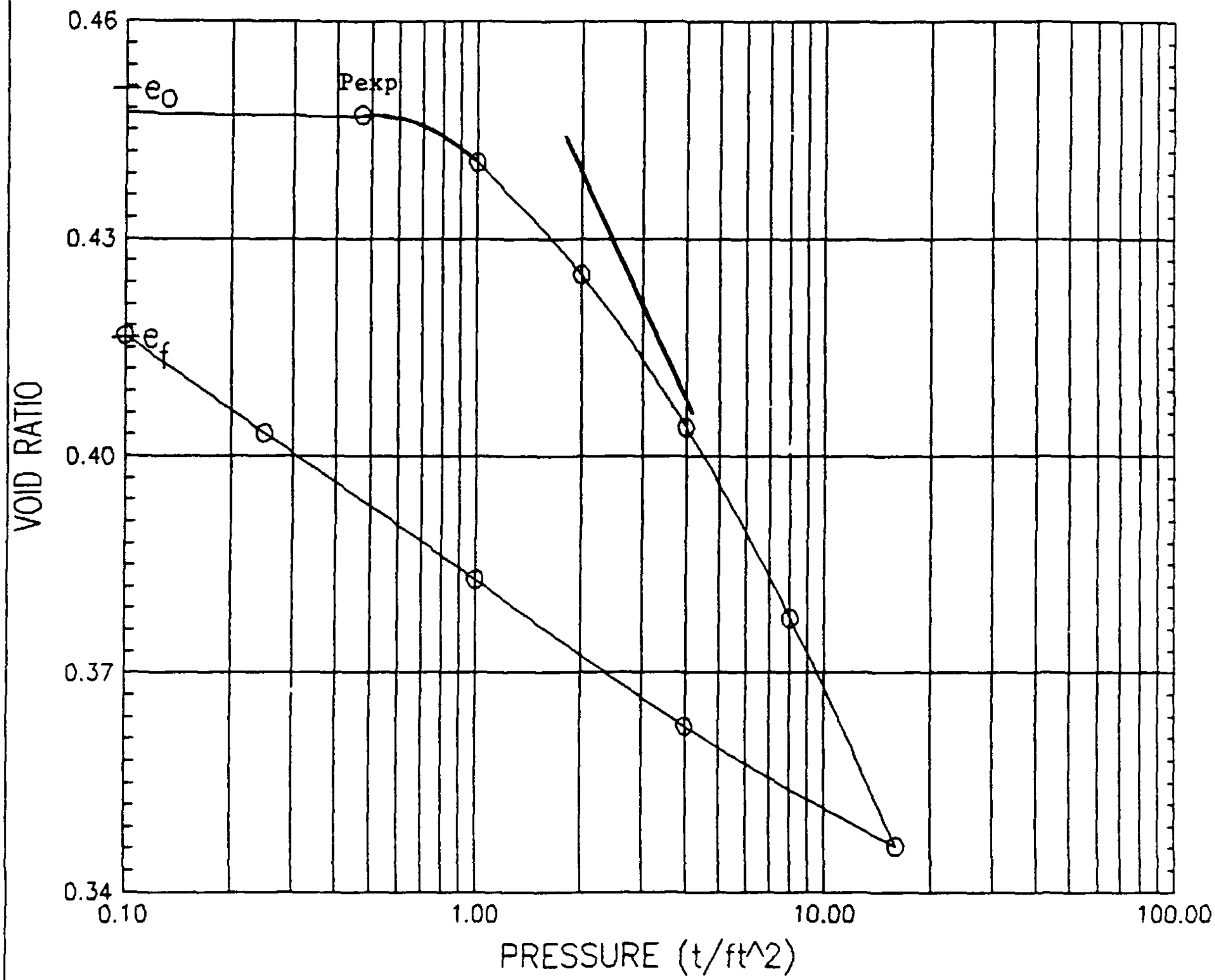
PROJECT: CUCHILLO DAM

SAMPLE LOCATION: STA. 1+600, ELEV. 4630
SWD LAB NO. 91/15

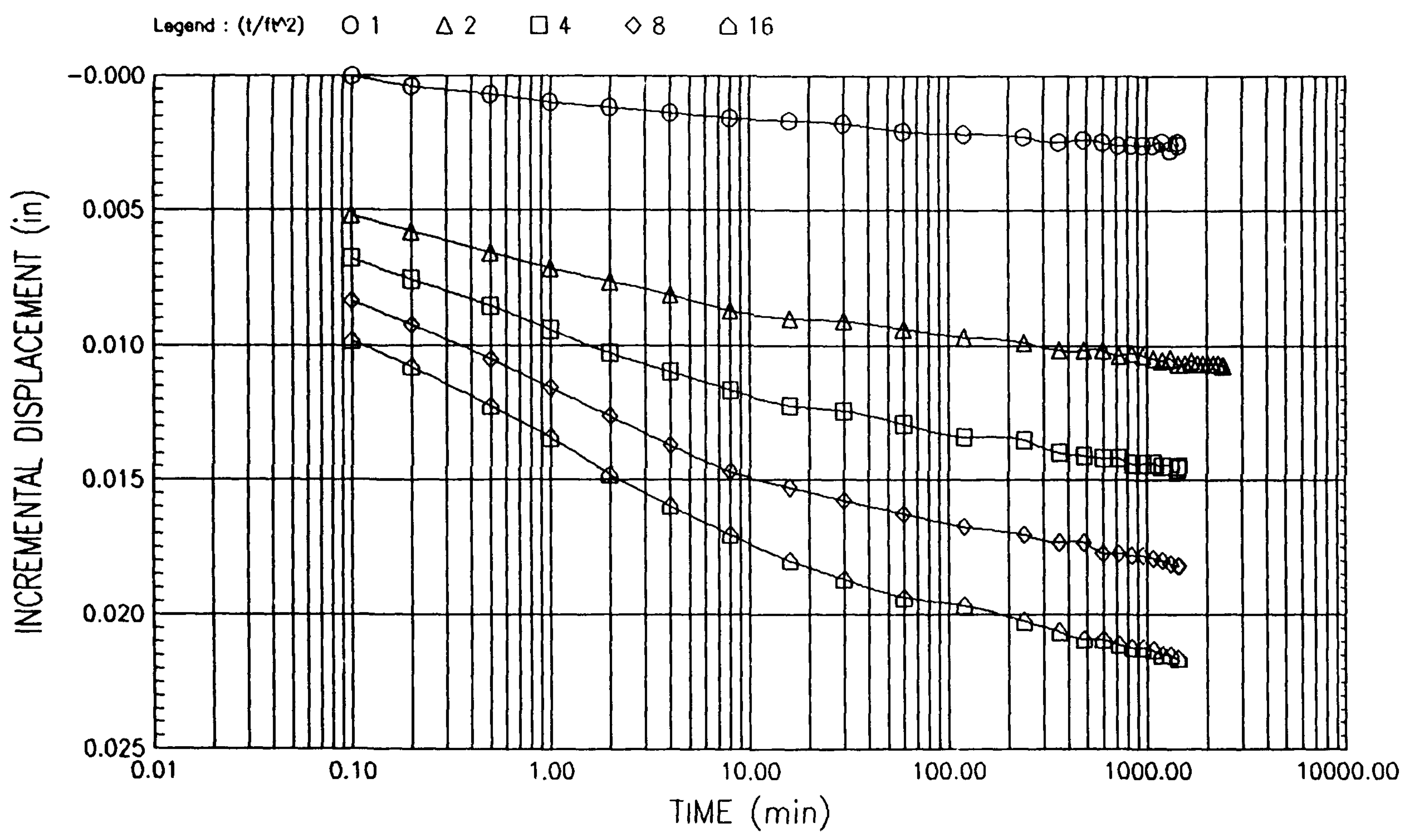
PROJ NO.: 15292 DATE: FEB 1991

DIRECT SHEAR TEST

CORPS OF ENGINEERS - SOUTHWESTERN



				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)	0.1		WATER CONTENT (%)	13.999	16.069
PRECONSOL. PRESSURE (t/ft^2)			DRY DENSITY (lb/ft^3)	115.746	118.539
COMPRESSION INDEX	0.10		SATURATION (%)	83.522	103.739
TYPE SPECIMEN			VOID RATIO	0.451	0.417
DIA. (in) 2.505	HT. (in) 1.000		BACK PRESSURE (t/ft^2)		
CLASSIFICATION SHALE					
LL 49.0	PL 23.0	PI 26.0	PROJECT CUCHILLO DAM		
GS 2.690	D 10		Data File: B:91-5.CNV		
REMARKS 1 + 35 D			BORING NO. LT. ABUTMT		SAMPLE NO. 91-5
□ Start-Swell O End-Swell			DEPTH 4640.0		DATE
SPECIFIC GRAVITY ESTIMATED			Army Corp of Engineers CONSOLIDATION TEST REPORT		

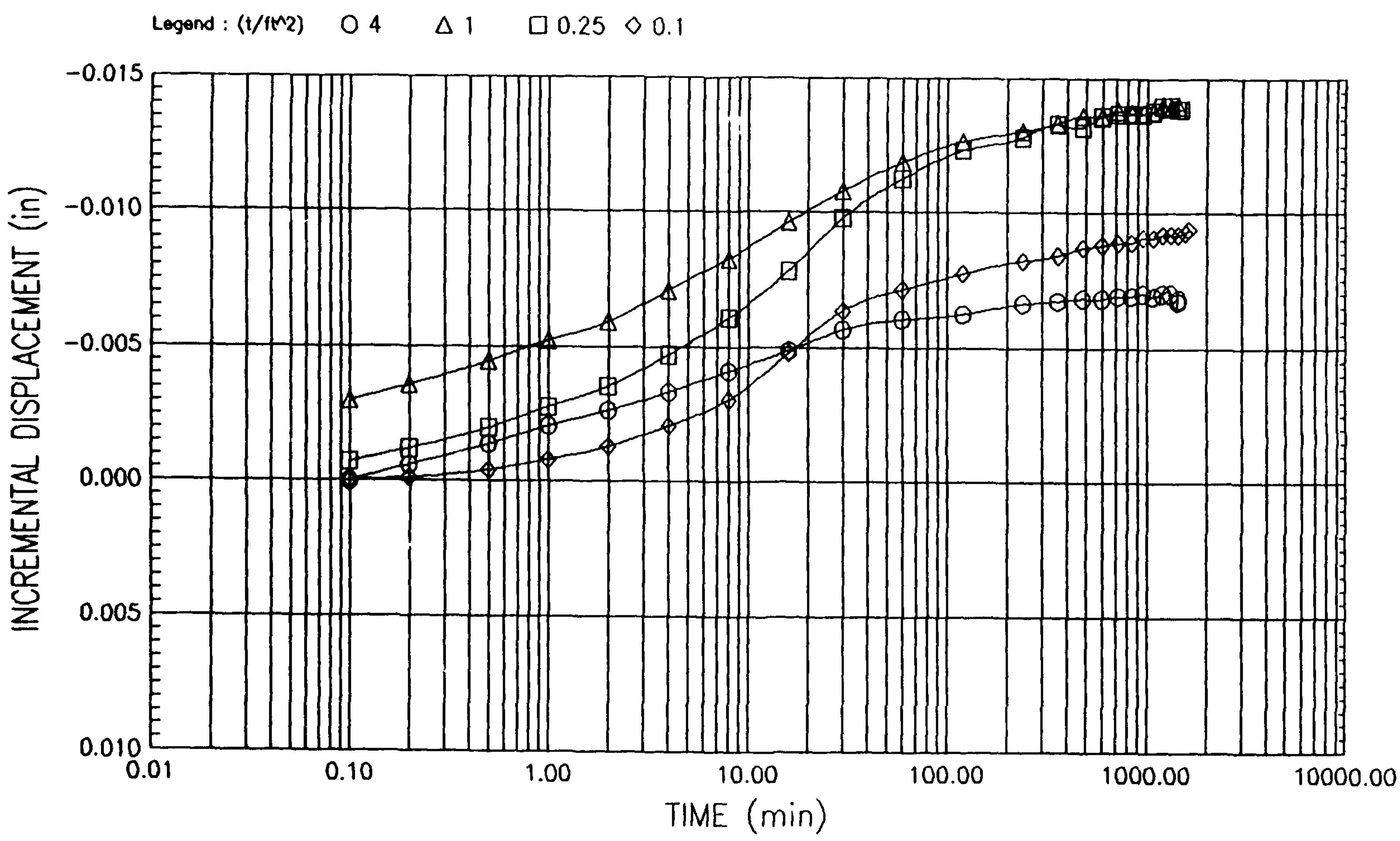


PROJECT	CUCHILLO DAM		
	Data File: B:91-5.CNV		
BORING	LT. ABUTMT	SAMPLE NO.	91-5
DEPTH	4640.0	DATE	

Army Corp of Engineers

CONSOLIDATION TEST

TIME CURVES

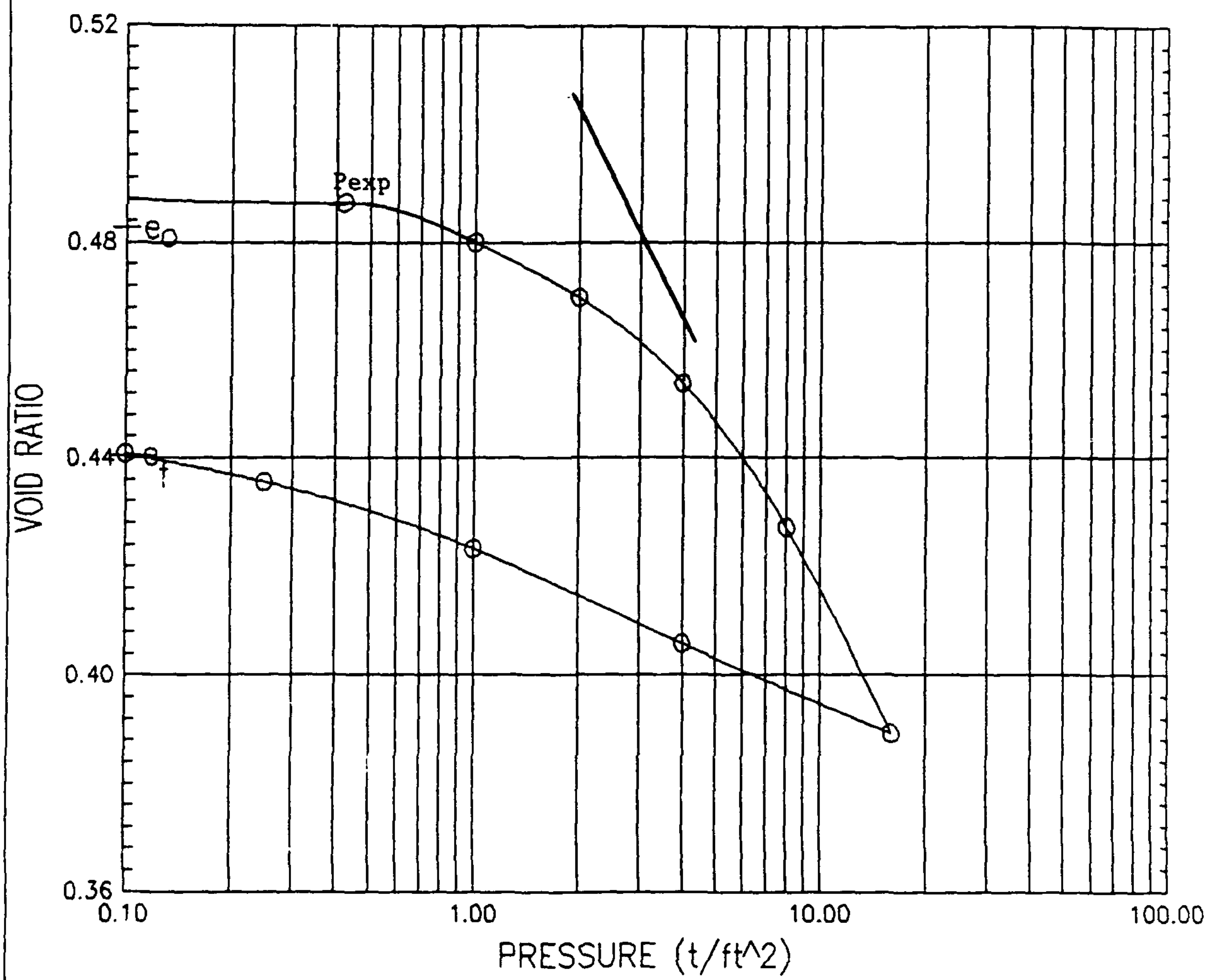


PROJECT	CUCHILLO DAM		
	Data File: B:91-5.CNV		
BORING	LT. ABUTMT	SAMPLE NO.	91-5
DEPTH	4640.0	DATE	

Army Corp of Engineers

CONSOLIDATION TEST

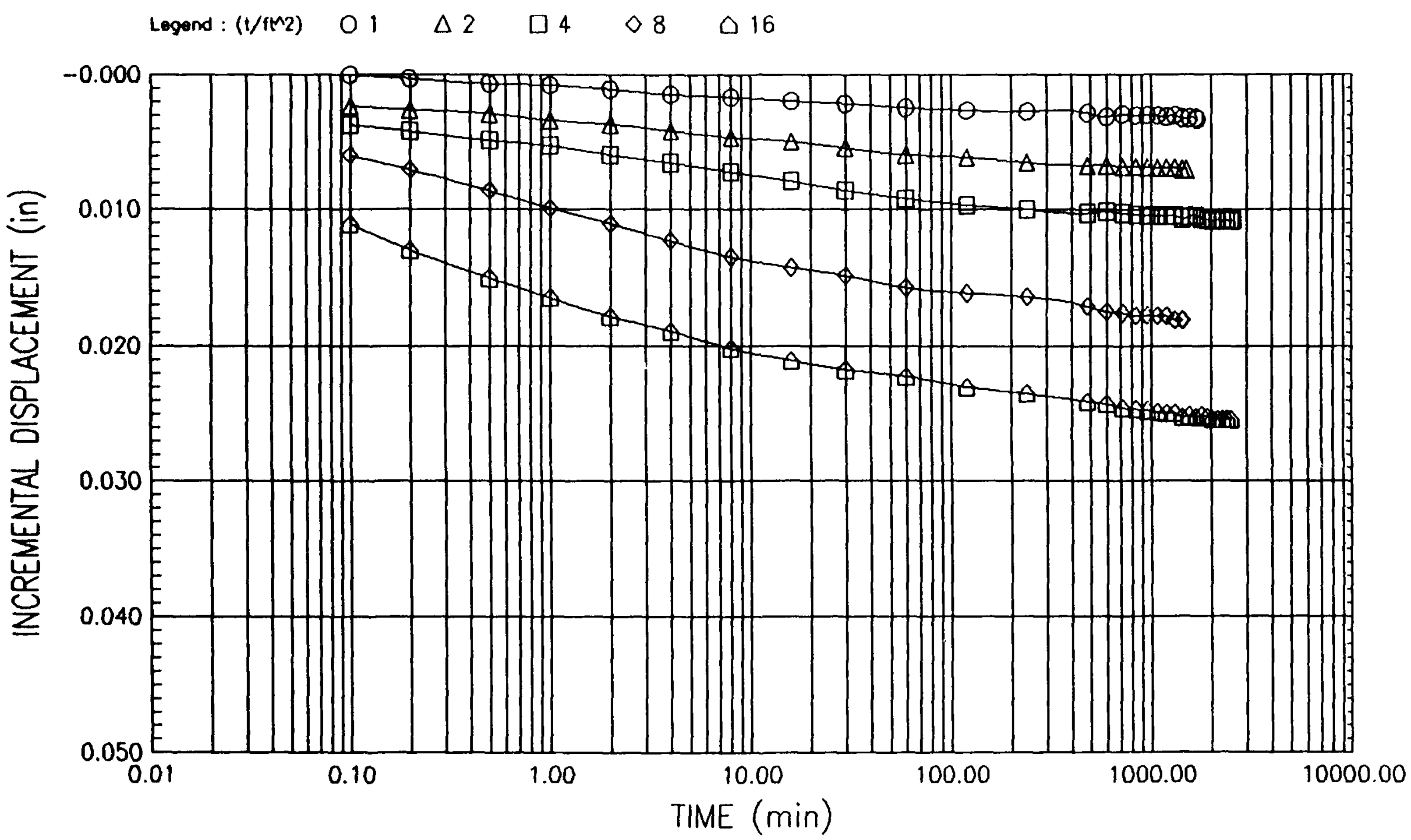
TIME CURVES



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)	0.1	WATER CONTENT (%)	14.266	16.382
PRECONSOL. PRESSURE (t/ft^2)		DRY DENSITY (lb/ft^3)	113.243	116.554
COMPRESSION INDEX	0.13	SATURATION (%)	79.465	99.973
TYPE SPECIMEN		VOID RATIO	0.483	0.441
DIA. (in) 2.505	HT. (in) 1.000	BACK PRESSURE (t/ft^2)		
CLASSIFICATION SHALE				
LL 52.0 / PL 27.0 / PI 25.0		PROJECT CUCHILLO DAM		
GS 2.690	D_{10}	Data File: B:91-7.CNV		
REMARKS 1 + 35 D		BORING NO. LT ABUTMT		SAMPLE NO. 91-7
□ Start-Swell O End-Swell		DEPTH 4640.0		DATE

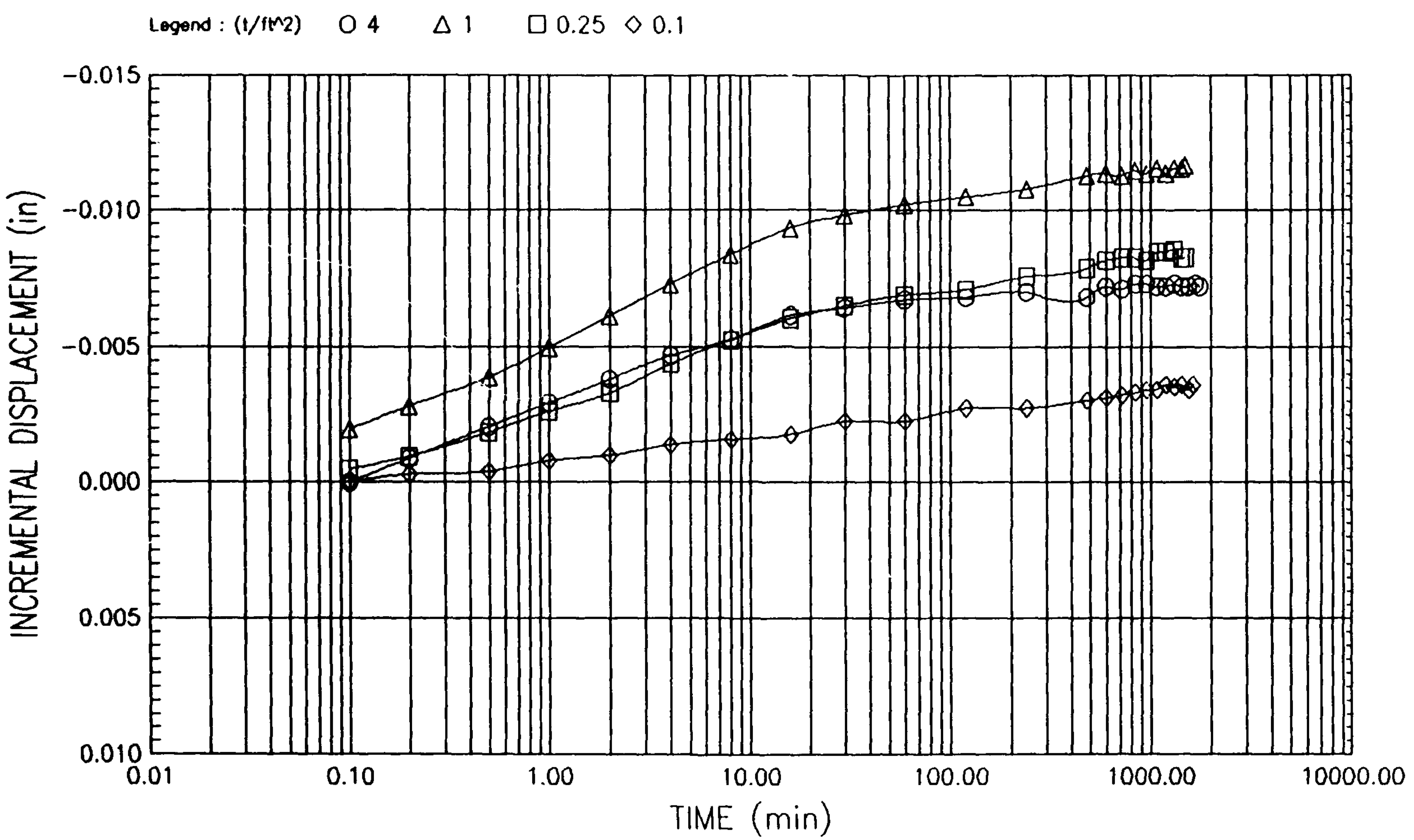
SPECIFIC GRAVITY ESTIMATED
SAMPLE APPROX. 40 % REMOLDED.

Army Corp of Engineers
CONSOLIDATION TEST REPORT



PROJECT	CUCHILLO DAM		
	Data File: B:91-7.CNV		
BORING	LT ABUTMT	SAMPLE NO.	91-7
DEPTH	4640.0	DATE	

Army Corp of Engineers
CONSOLIDATION TEST
TIME CURVES

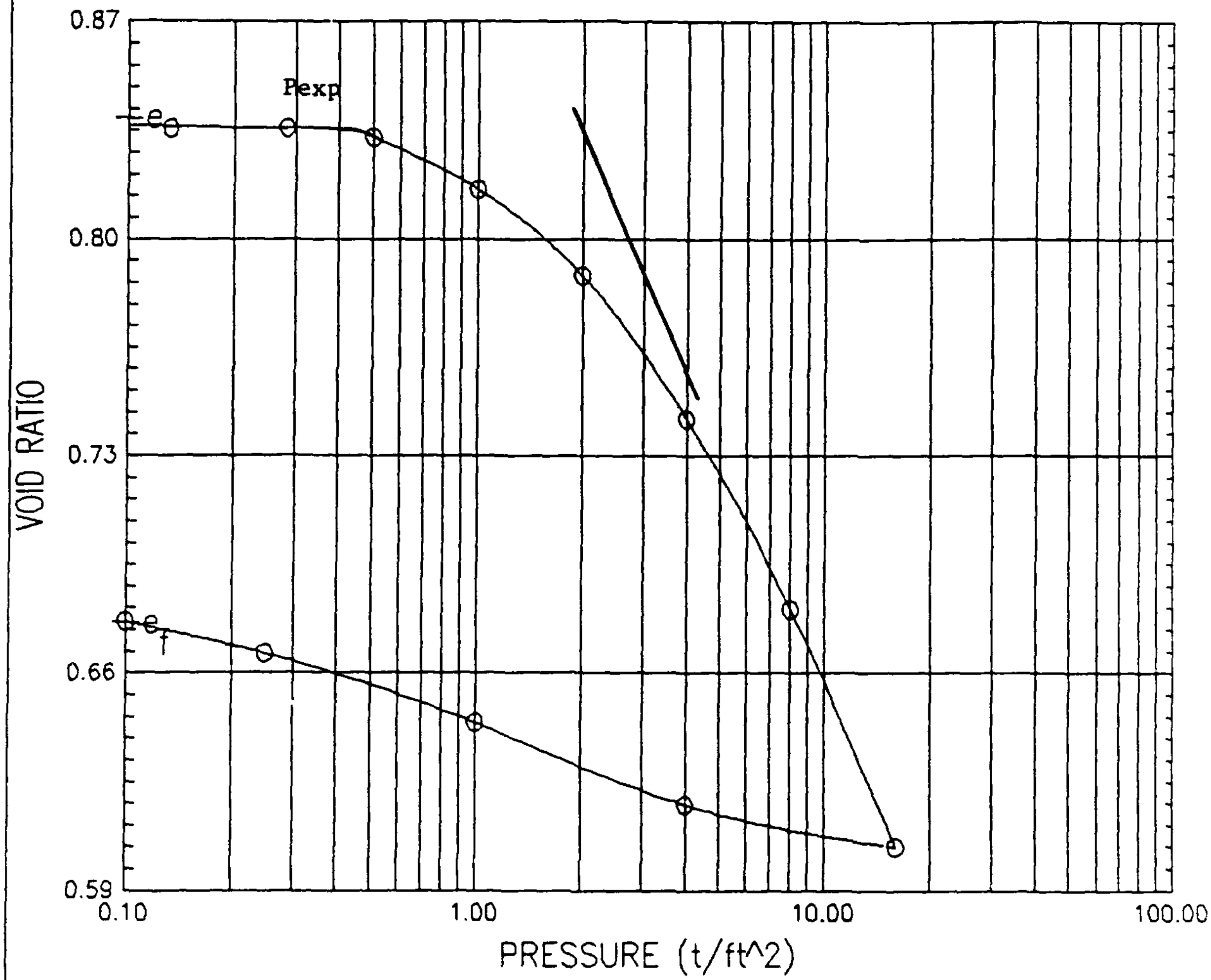


PROJECT	CUCHILLO DAM		
	Data File: B:91-7.CNV		
BORING	LT ABUTMT	SAMPLE NO.	91-7
DEPTH	4640.0	DATE	

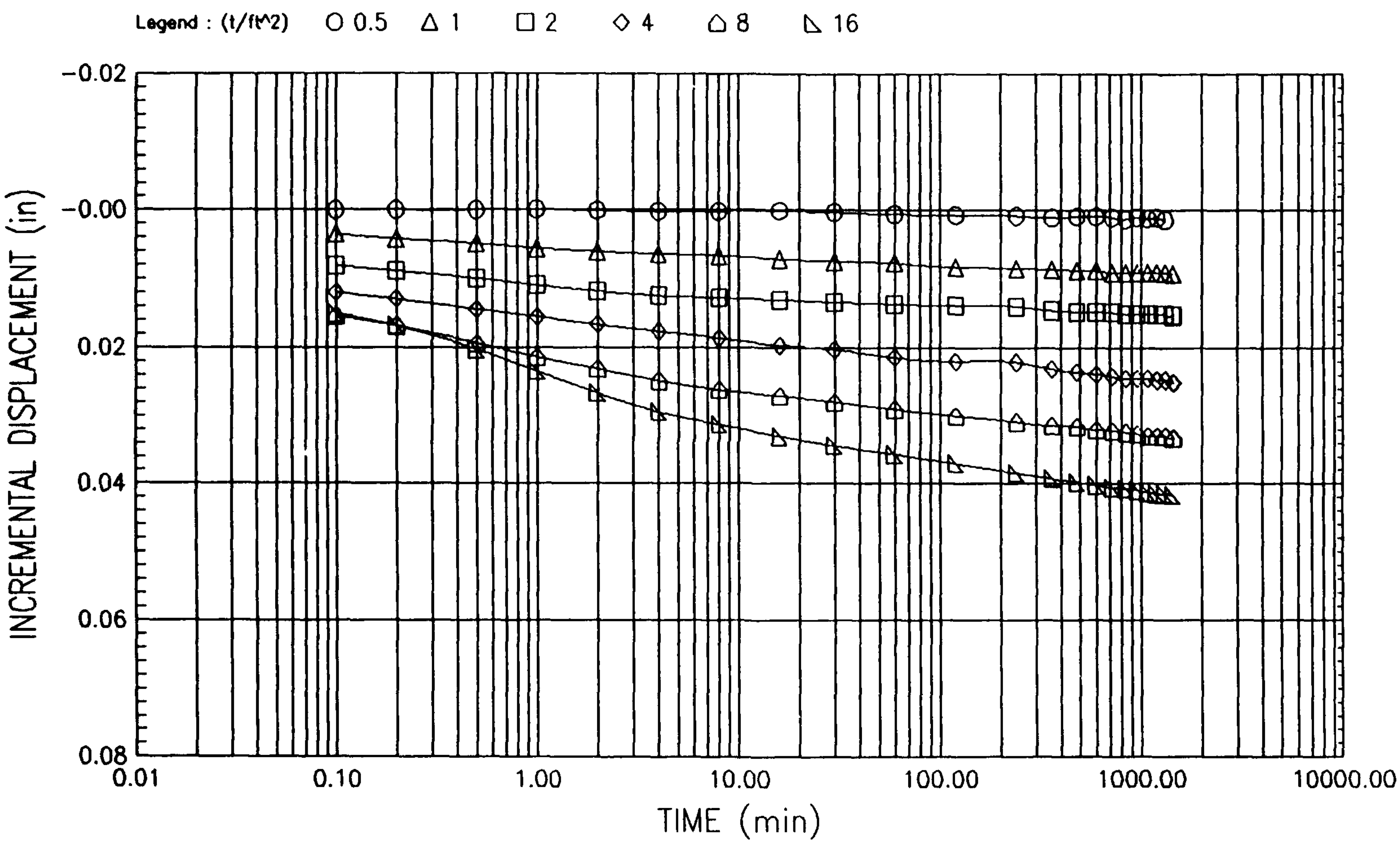
Army Corp of Engineers

CONSOLIDATION TEST

TIME CURVES

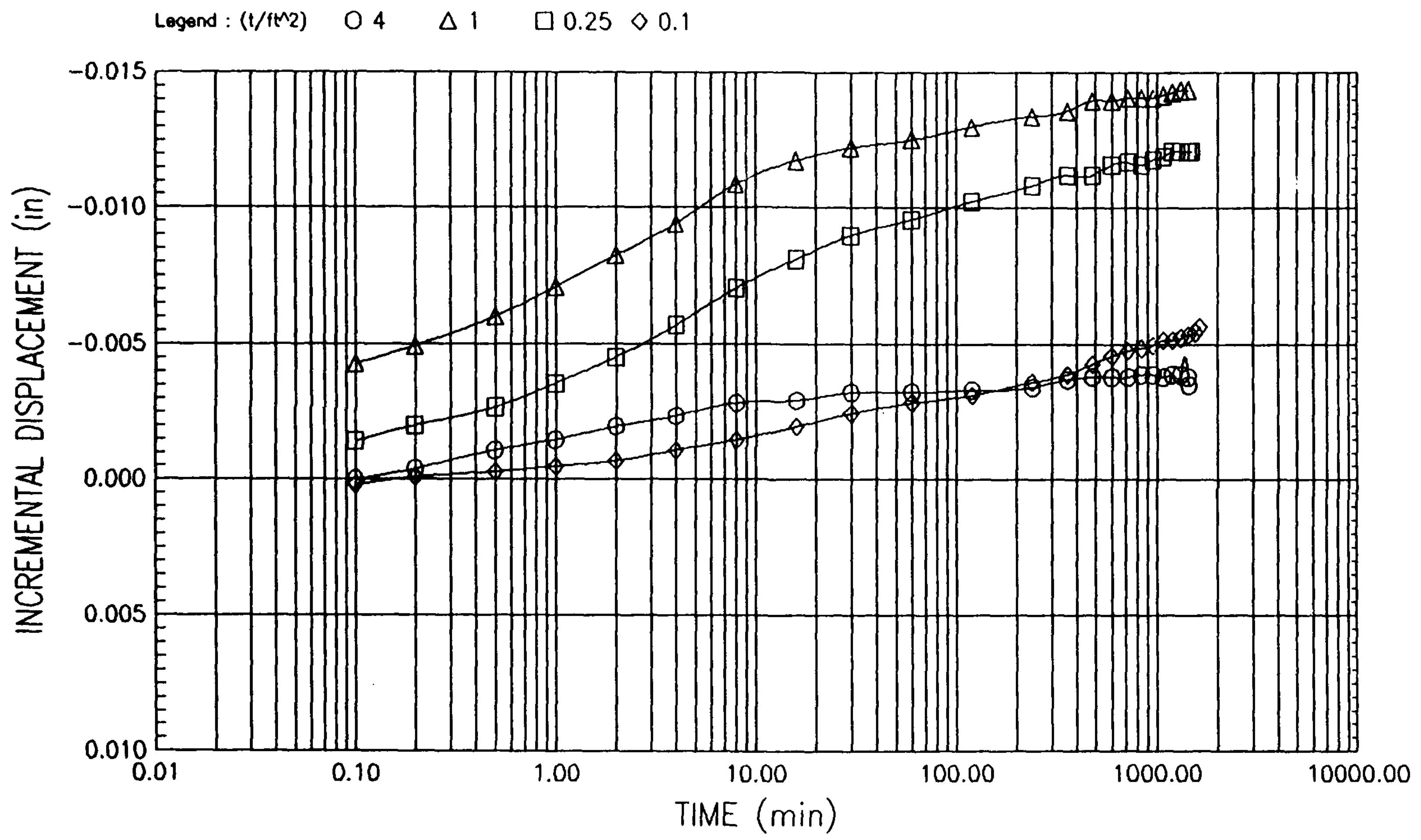


				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)		0.1	WATER CONTENT (%)	11.770	26.080
PRECONSOL. PRESSURE (t/ft^2)			DRY DENSITY (lb/ft^3)	91.290	100.161
COMPRESSION INDEX		0.27	SATURATION (%)	37.712	103.685
TYPE SPECIMEN			VOID RATIO	0.840	0.677
DIA. (in) 2.505	HT. (in) 1.000		BACK PRESSURE (t/ft^2)		
CLASSIFICATION FAT CLAY (CH), POSSIBLE SHALE					
LL 50.0	PL 24.0	PI 26.0	PROJECT CUCHILLO DAM		
GS 2.690	D_{10}		Data File: B:91-9.CNV		
REMARKS 1 + 55 D			BORING NO. LT ABUTMT		SAMPLE NO. 91-9
☐ Start-Swell ○ End-Swell			DEPTH 4635.0		DATE
SPECIFIC GRAVITY ESTIMATED			Army Corp of Engineers CONSOLIDATION TEST REPORT		



PROJECT	CUCHILLO DAM		
	Data File: B:91-9.CNV		
BORING	LT ABUTMT	SAMPLE NO.	91-9
DEPTH	4635.0	DATE	

Army Corp of Engineers
CONSOLIDATION TEST
TIME CURVES

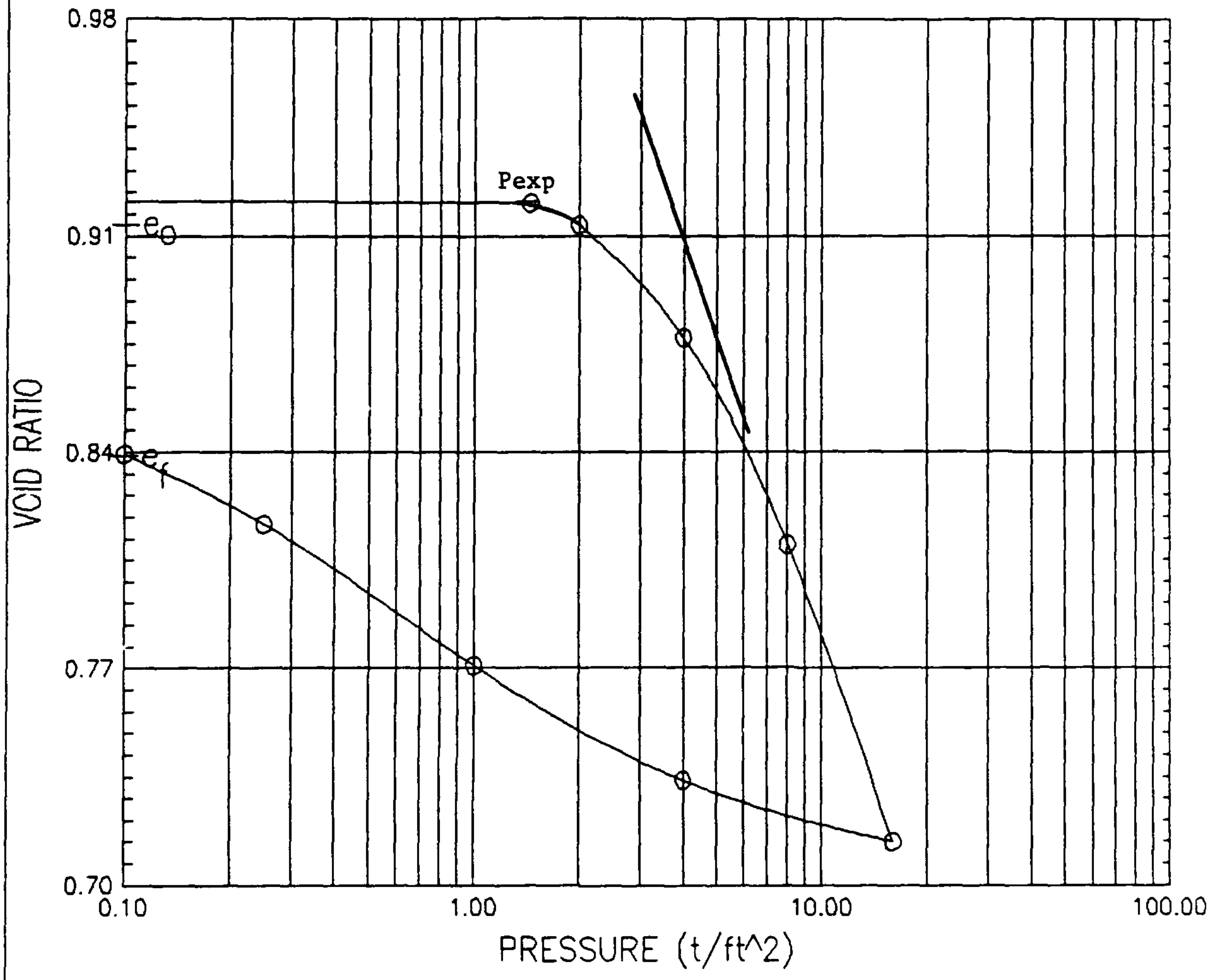


PROJECT	CUCHILLO DAM		
	Data File: B:91-9.CNV		
BORING	LT ABUTMT	SAMPLE NO.	91-9
DEPTH	4635.0	DATE	

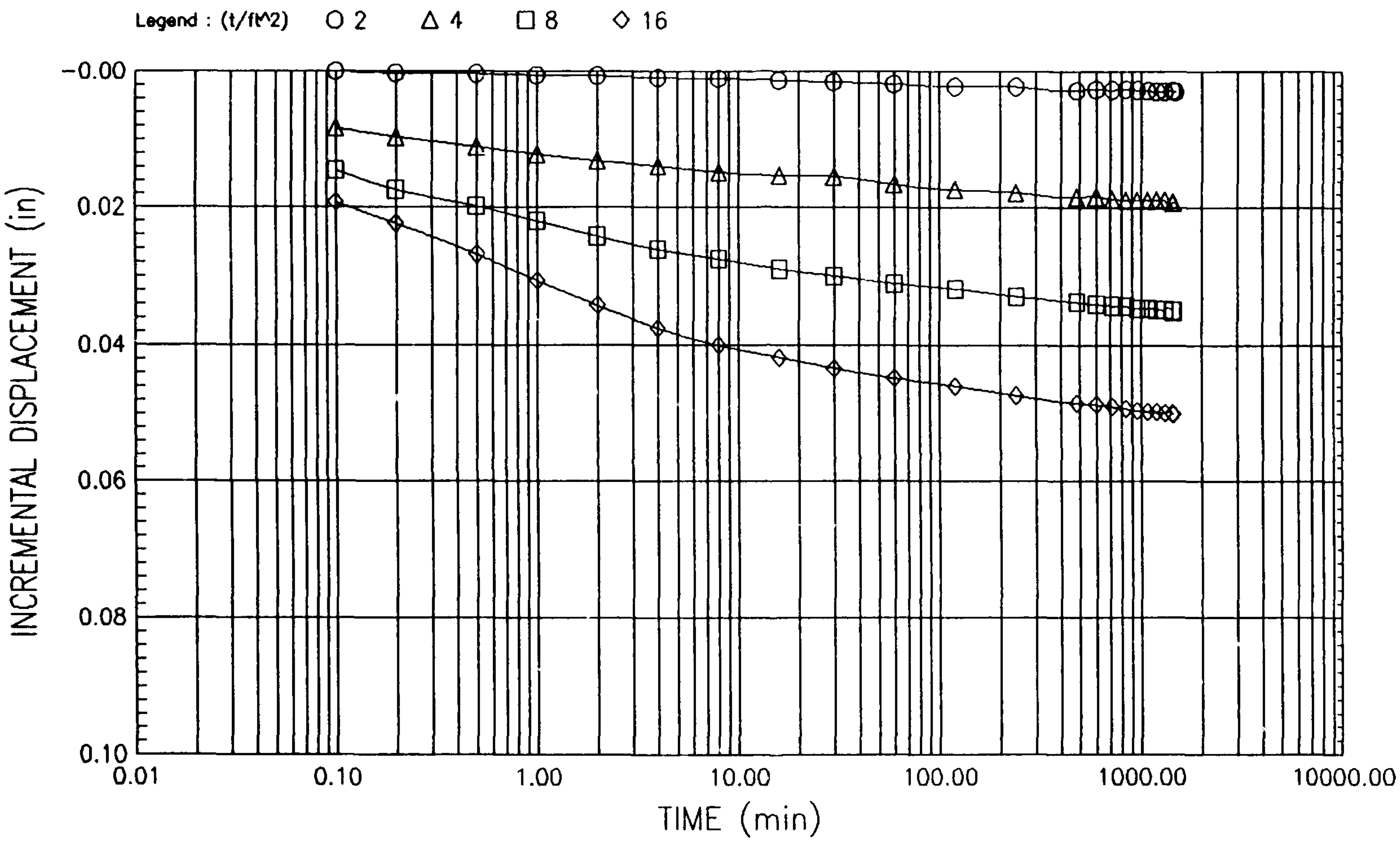
Army Corp of Engineers

CONSOLIDATION TEST

TIME CURVES



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE (t/ft^2)	0.1	WATER CONTENT (%)	13.223	31.727
PRECONSOL. PRESSURE (t/ft^2)		DRY DENSITY (lb/ft^3)	87.728	91.301
COMPRESSION INDEX	0.33	SATURATION (%)	38.908	101.684
TYPE SPECIMEN		VOID RATIO	0.914	0.839
DIA. (in) 2.505	HT. (in) 1.000	BACK PRESSURE (t/ft^2)		
CLASSIFICATION SHALE				
LL / PL / PI		PROJECT CUCHILLO DAM		
GS 2.690	D_{10}	Data File: B:15.CNV		
REMARKS		BORING NO. STA. 1+600		SAMPLE NO. 91/15
□ Start-Swell ○ End-Swell		DEPTH 4630		DATE
SPECIFIC GRAVITY ESTIMATED		Army Corp of Engineers		
SAMPLE PARTIALLY REMOLDED		CONSOLIDATION TEST REPORT		

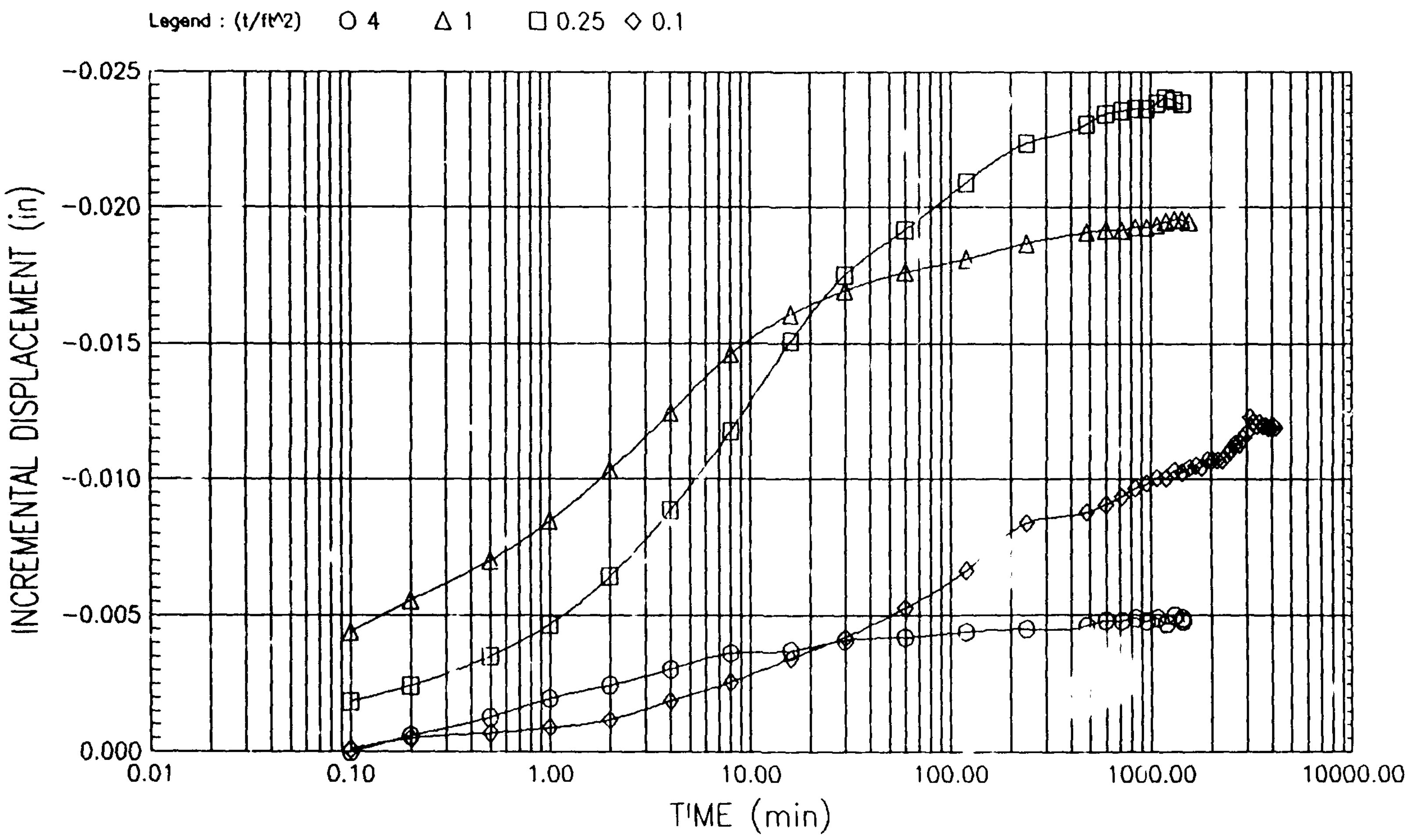


PROJECT	CUCHILLO DAM		
	Data File: B:15.CNV		
BORING	STA. 1+600	SAMPLE NO.	91/15
DEPTH	4635	DATE	

Army Corp of Engineers

CONSOLIDATION TEST

TIME CURVES



PROJECT	CUCHILLO DAM		
	Data File: B:15.CNV		
BORING	STA. 1+600	SAMPLE NO.	91/15
DEPTH	4635	DATE	

Army Corp of Engineers

CONSOLIDATION TEST

TIME CURVES

Geophysical Logs and Report

Summary of Cuchilla Negro Geophysical Logs

Geophysical logs were made in 14 wells, by the U.S. Geological Survey logger, in the Cuchillo Negro dam-site location during May 1988. The cored-holes generally traverse the proposed location of a flood-water retention dam across Cuchillo Negro Wash and the spill-way location in an adjacent tributary.

Three of the holes originally planned for logging, had caved too shallow for usable logs. Two, of the 14 holes logged, were very shallow so only gamma logs were made in those. Natural Gamma, Gamma-Gamma Density, Neutron, and Caliper logs were made in the 12 deepest holes.

All of the holes showed a fracture zone except the northern-most (CH-17) and the southern-most (CH-22) which are situated on the highest elevations. The formation outcrops indicate an east-northeast dip of approximately 25 degrees making correlation of the lithology, from hole-to-hole, very difficult. The logs exhibit anomalies indicative of a very dirty subordinate limestone to clean limestone separated by layers of shale and clay. The clean limestone layers are relatively thin and pinch-out to zero in places but where it is present, few fractures appear in it. The fracture sections appear mostly in the shale sections, and the limestone/calcite sections, and generally at random without direct communications to areal holes. Any movement of ground-water would necessitate, vertical as well as horizontal flow, because of the apparent block-like nature of the formations, therefore areal permeability would be very low.

The attached over-lay, showing well locations, altitude of the land-surface, and altitude of the encountered fracture zones, indicate a fracture at

approximately 4,632 above MSL, that may be an exception. However, when the Gamma logs of the wells encountering the 4,632 fracture are compared, it is obvious that the section is not continuous and therefore not directly related.

Four of the holes contained a small amount of water and the Neutron logs show seeps in the fracture areas of these holes but not in others, leading to the belief that this is perched water or drilling fluid.

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Casing Data

Casing: Diam. __ in. __ ft. to __ ft. Thickness __ in.
Diam. __ in. __ ft. to __ ft. Thickness __ in.
Diam. __ in. __ ft. to __ ft. Thickness __ in.

Bore: Diam. __ in. __ ft. to __ ft.
Diam. __ in. __ ft. to __ ft.
Diam. __ in. __ ft. to __ ft.

Filter: Type __ Thickness __ Characteristics,
__ ft, to __
__ ft, to __

Perforations, Screen: Type, size __
__ ft, to __
__ ft, to __

Water Level __ ft. (above, below) __, which is __ ft. (above, below) surface. Shut-in head after __ (hrs., mins.)
Date Nov. 17, 1977

Total Depth 99.5 ft. Interval Logged __ ft. to __ ft.

Fluid in hole: __ Characteristics __
Fluid level __ ft. Fluid Temperature __ °F.
Date __ Date __
Water: Temperature __ °F. at __. Field Cond. __
Ra(uu c/L __ Beta-Gamma (uu c/L __ U(10-3 gr/l __

Owner or Field No. S.H.I. Camp at King
Project name Caballo Negro
Geological Survey No. __
State NM County Sierra
Location __
__ ¼ __ ¼ __ ¼ __ ¼ Sec. __ T __ N/S R __ E/W
Depth Datum: __
which is __ ft. (above, below) land surface.
Altitude: MP __ ft. Land surface 4714 ft
Determined by __
Operator(s) Hudson - Dewees
Equipment (Vehicle No.) __ Date __

Logging Data

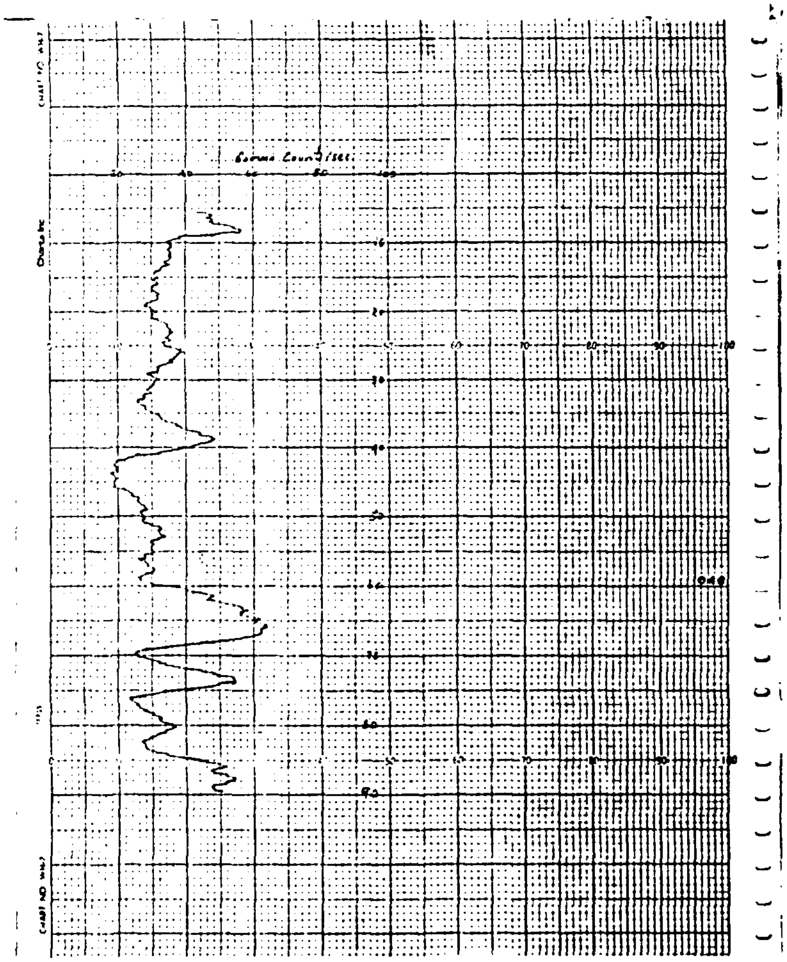
Run No. __ of __ runs. Probe Sensitivity (High
Descent: __ ft./min. Gamma-Ray circuit scale __
Potential circuit scale __ Time constant __
Logged out: __ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 1.0 Time constant 2

Statistical Variation __ in. at __ ft. Meter Reading __ G-R Scale __ Time Constant __

Calibration in hole: (G-R Scale __ Pot. circ. scale __)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks __

Radiation intensity increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

NEUTRON LOG

HOLE LOGGING DATA

Casing: Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.

Bore: Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.

Water Level ____ ft. (above,below) ____ ____, which is ____ ft. (above,below) surface. Shut-in head after ____ (hrs.,mins.)

Date May 15, 1981

Depth drilled (feet): ____

Depth Measured (feet): 89

Interval logged: ____ ft. to ____ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.

Vertical Scale 10 ft./in.

Source 3 curries AM-BE Spacers 17 in.

Horz. Scale 1K T.C. 2 sec.

Sens. Scale 1.0 Base Scale 1.0

Owner or Field No. CH-1 Corp of Eng

Project Name Cuchillo Negro

U.S.G.S. No. ____ Town ____

State NM County or Parish Sierra

Location ____

____ ¼ ____ ¼ ____ ¼ ____ ¼ Sec. ____ T ____ N/S R ____ E/W

Depth Datum: ____, which is ____ ft. (above, below) land surface.

Altitude: MP ____ ft. Land surface ____ ft.

Determined by ____

Operator(s) Hudson - Dewees

Equipment ____ Date ____

Equipment No.: ____ Vehicle No. ____

FLUID DATA

Type: ____

Density, lbs./gal. ____

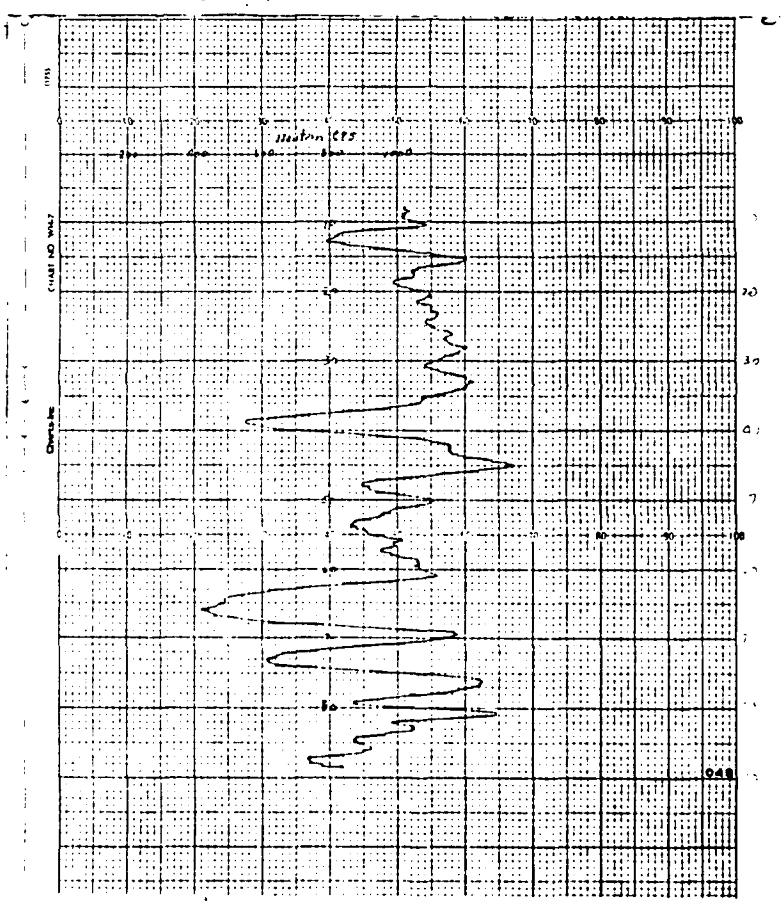
Viscosity, sec. ____

Resistivity, ohms: ____

Resistivity, B.H.T., ohms: ____ pH: ____

Circ. Temp.: ____ B.H. Temp.: ____

Remarks: Possibly [illegible] left



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or Field No. ______

Project Name Cochillo Negro

Geological Survey No. ______

State NM County Sierra

Location ______

___ ¼ ___ ¼ ___ ¼ ___ ¼ Sec. ___ T ___ N R ___ E/W

Depth Datum ______, which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface 4140 ft

Determined by ______

Operator(s) Hudson - Dedres

Equipment (vehicle No.) ______ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics, ______
______ ft, to ______
______ ft, to ______

Perforations, Screen: Type, size ______
______ ft, to ______
______ ft, to ______

Water Level ______ ft. (above, below) ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 19, 1981

Total Depth ______ ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole: ______ Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______

Water: Temperature ______ °F. at ______. Field Cond. ______
Ra(uu c/l ___ Beta-Gamma (uu c/l ___ U(10-3 gr/l ______

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High

Descent: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ___

Logged out: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ___

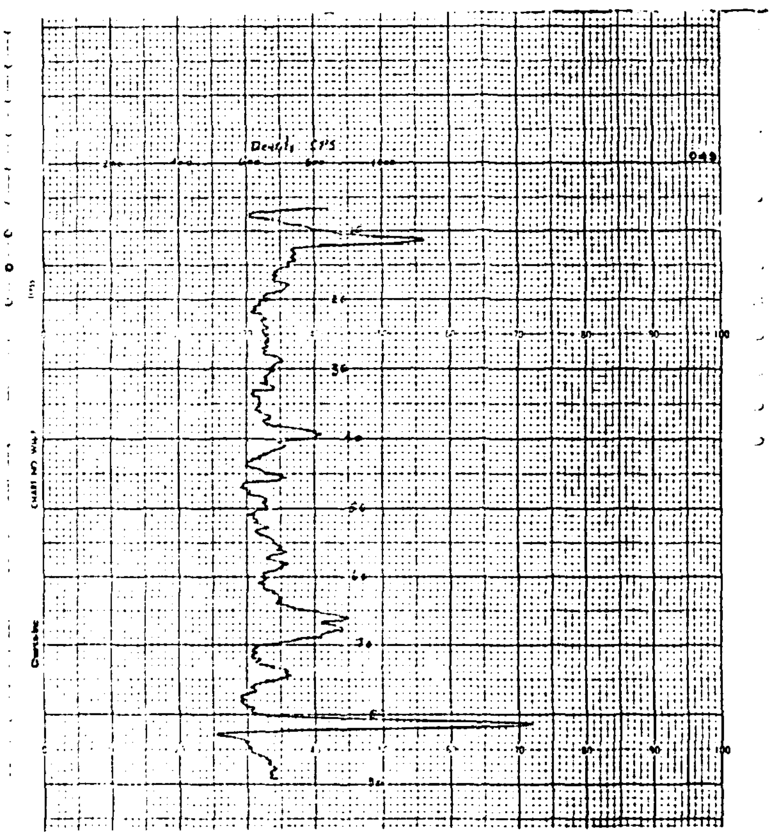
Statistical Variation ______ in. at ______ ft. Meter Reading ______ G-G Scale ______ Time Constant ______

Calibration in hole: (G-G Scale ______ Pot. circ. scale ___)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks Bulk density near left

Radiation intensity increase ⟶ Depth Scale 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field no. CH-1 Corps of Eng
Project name Cuchillo Negro
U.S.G.S. no. ______ Town ______
State NM County or Parish Sierra
Location ______
___¼___¼___¼___¼ Sec.___ T.___ N/S R.___ E/W
Depth Datum: ______, which is ______ ft. (above, below) land surface.
Altitude MP ___ ft. Land surface ______ ft.
Determined by ______
Operator(s) Hudson - Dewees
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing. Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

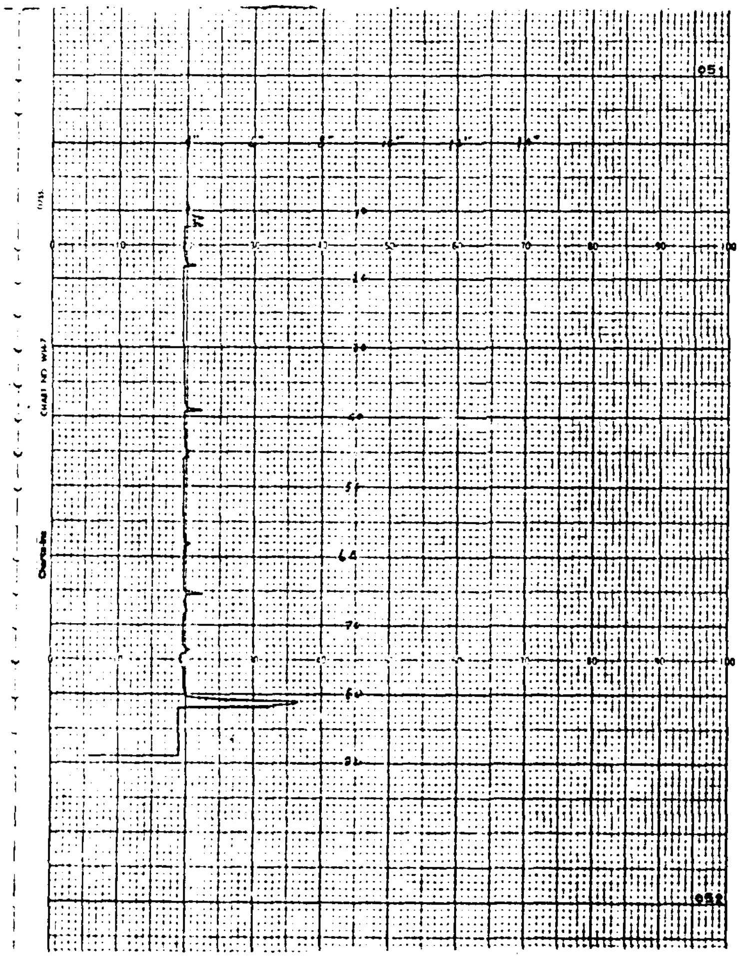
Water Level ______ ft. (above, below) ______
______, which is ___ ft. (above, below)
surface. Shut-in head after ______ (hrs., mins.)
Date May 19, 1981
Depth drilled (feet) ______
Depth measured (feet) 19
Interval logged. ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: Two in./in.

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: ______



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Geological Survey No. CH-3 Corp. of Eng.
State NM County Dona Ana

Location ____
___¼___¼___¼___¼ Sec. ___T.___ R.___

Depth Datum: ____
which is ____ ft. (above, below) land surface.
Altitude: MP ____ ft. Land surface 4705 ft
Determined by ____
Operator(s) Hudson - Dentes
Equipment (Vehicle No.) ____ Date ____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ____ Thickness ____ Characteristics,
____ ft. to ____ ____
____ ft. to ____ ____

Perforations, Screen: Type, size ____
____ ft. to ____
____ ft. to ____

Water Level ____ ft. (above, below) ____, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date May 18, 1978

Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F.
Date ____ Date ____

Water: Temperature ____ °F. at ____. Field Cond. ____
Ra(uu c/l ____ Beta-Gamma (uu c/l ____ U(10-3 gr/l ____

Logging Data

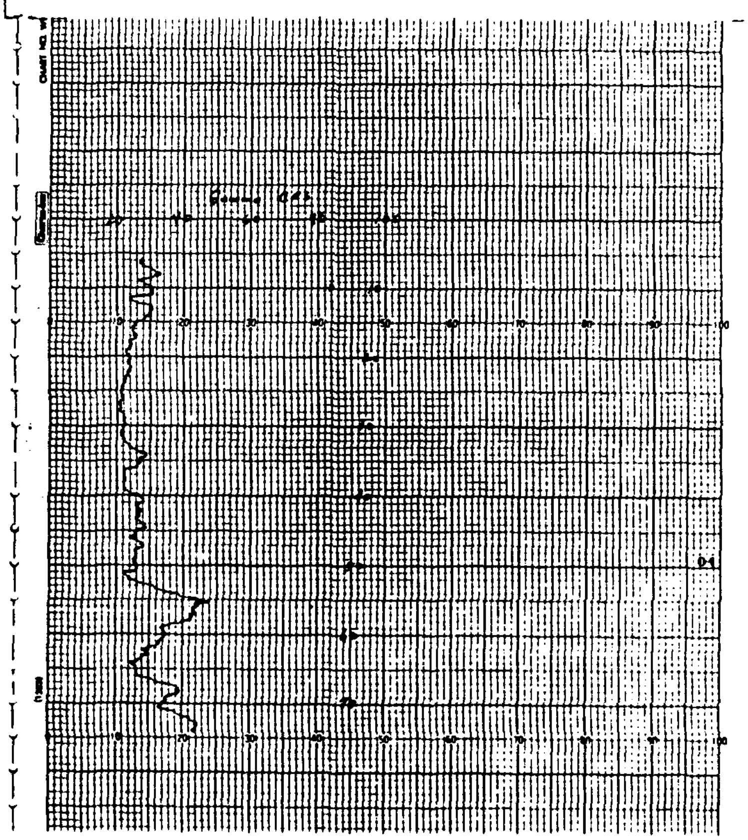
Run No. ____ of ____ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale ____ Time constant ____
Logged out: ____ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 1.0 Time constant 3

Statistical Variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ____)
Depth (Ft.) Obs. Time (min.) Meter Reading

Remarks ____

Radiation intensity increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CH-3 Corp of Eng
Project Name Cuchillo Negro
U.S.G.S. No. ______ Town ______
State NM County or Parish Sierra
Location ______
___¼___¼___¼___¼ Sec.___ T___ N S R___ E W

Depth Datum: ______, which is ______ ft. (above, below) land surface.
Altitude: MP ______ ft. Land surface 4705 ft.
Determined by ______
Operator(s) Hudson - Dewees
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

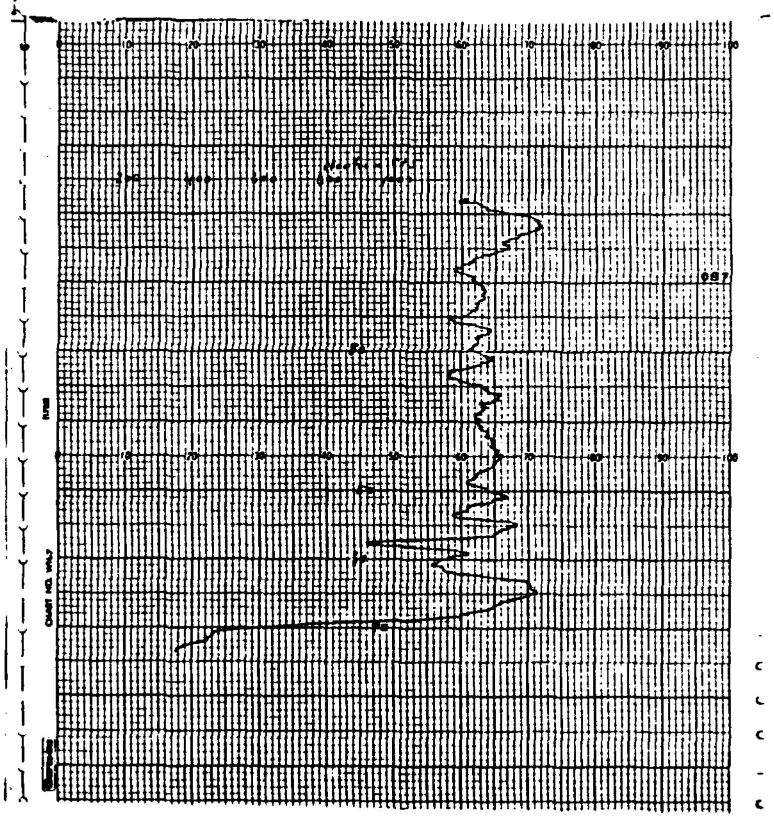
Water Level ______ ft. (above, below) ______ ______, which is ______ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date May 18, 1977
Depth drilled (feet): ______
Depth Measured (feet): 74
Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 curries AM-BE Spacers 17 in.
Hors. Scale 115 T.C. 2 sec.
Sens. Scale 1.0 Base Scale 10.0

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: Porosity Moisture max. 6 ft



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Survey or Field No: CH-3 Corps of Eng
Project Name: Cuchillo Negro
Geological Survey No.
State: NM County: Sierra
Location
Sec. T. R.
Depth Datum
which is ft. (above, below) land surface.
Altitude: MP ft. Land surface 4705 ft
Determined by
Operator(s) Hudson - Dukes
Equipment (Vehicle No.) Date

Casing Data

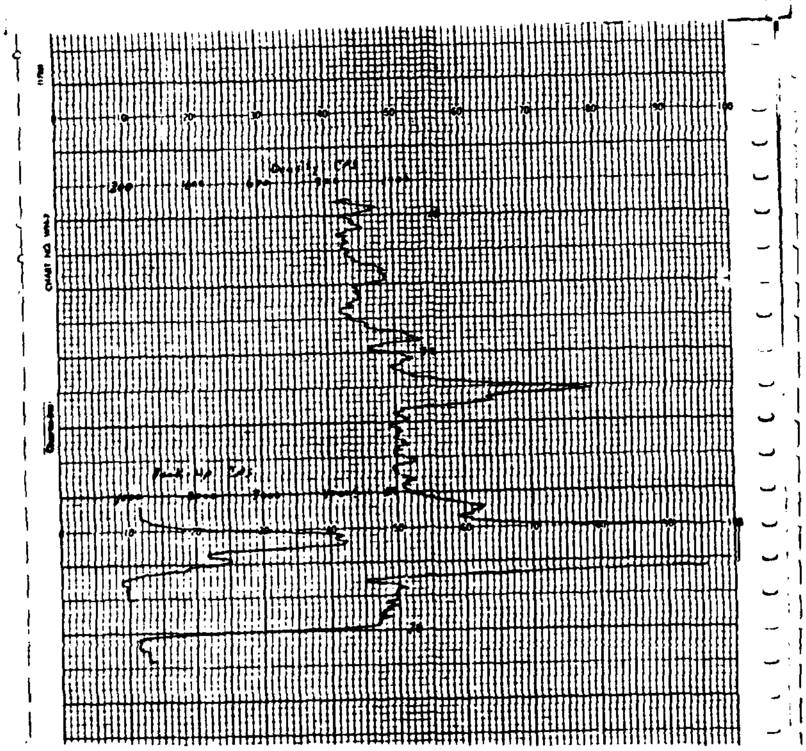
Casing: Diam. in. ft. to ft. Thickness in.
Diam. in. ft. to ft. Thickness in.
Diam. in. ft. to ft. Thickness in.
Bore: Diam. in. ft. to ft.
Diam. in. ft. to ft.
Diam. in. ft. to ft.
Filter: Type Thickness Characteristics
ft. to
ft. to
Perforations, Screen: Type, size
ft. to
ft. to
Water Level ft. (above, below) ..., which is ft. (above, below) surface. Shut-in head after (hrs., mins.)
Date May 18, 1978
Total Depth ft. Interval Logged ft. to ft.
Fluid in hole: Characteristics
Fluid level ft. Fluid Temperature °F.
Date Date
Water: Temperature °F. at . Field Cond.
Below c/A Beta-Gamma (on c/A μ(10-3 gr/l)

Logging Data

Run No. of runs. Probe Sensitivity High
Descent: ft./min. Gamma-Ray circuit scale
Potential circuit scale Time constant
Logged out: ft./min. Gamma-Ray circuit scale 100/500
Potential circuit scale 1.0 Time constant
Statistical Variation in. at ft. Meter Reading E-B Scale Time Constant
Calibration in hole: (E-B Scale Pot. circ. scale)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks Bulk density incr. left

Radiation intensity increase → Depth Scale: 10 ft./in.



Owner or field no. Alt 3 Corp of Eng

Project name Cuchillo Negro

U.S.G.S. no. ______ Town ______

State NM County or Parish Sierra

Location ______

___¼ ___¼ ___¼ ___¼ Sec. ___ T. ___ N/S R. ___ E/W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude: MP __ ft. Land surface 4705 ft.

Determined by ______

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

CALIPER LOG

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______ ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 18, 1988

Depth drilled (feet) ______

Depth measured (feet) 74

Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 20 ft./min.

Vertical scale: 10 ft./in.

Horizontal scale: Two in./in.

Operator(s) Hudson - Dewees

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

FLUID DATA

Type: ______

Density, lbs./gal. ______

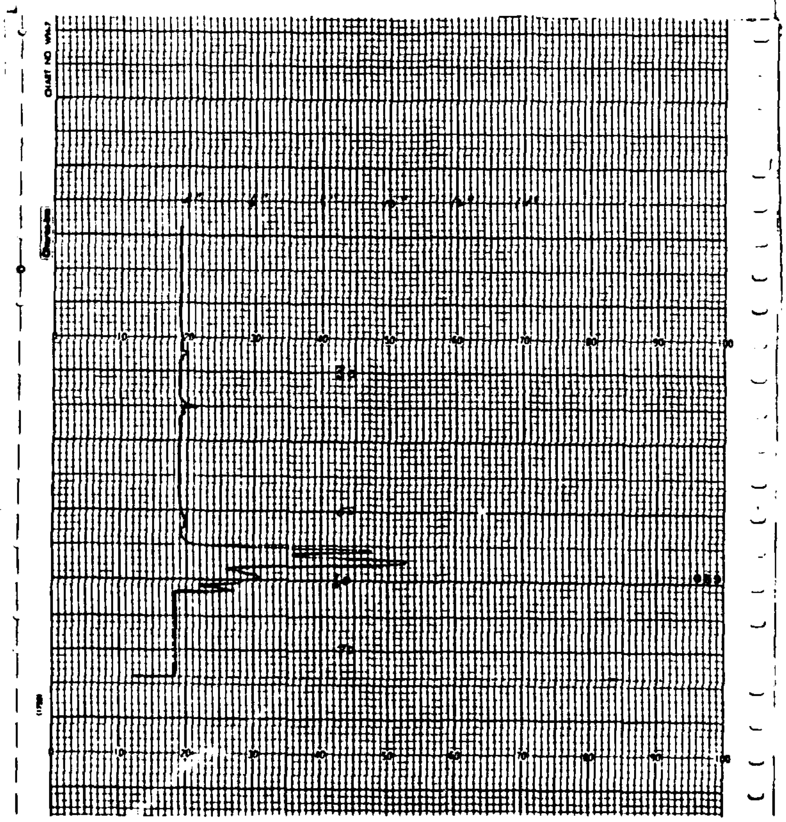
Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

Remarks: ______



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA LOG

Geological Survey No. CH-9 Cop. of Eng.
State Sierra County ______
Location Cuchillo Negro
___ ¼ ___ ¼ ___ ¼ ___ ¼ Sec. ___ T. ___ R. ___
Depth Datum: ______,
which is ______ ft. (above, below) land surface.
Altitude: MP ______ ft. Land surface 4732 ft.
Determined by ______
Operator(s) Hudson · Dawkins
Equipment (Vehicle No.) ______ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics,
______ ft. to ______ ______
______ ft. to ______ ______

Perforations, Screen: Type, size ______
______ ft. to ______
______ ft. to ______

Water Level ______ ft. (above, below) ______
______, which is ___ ft. (above, below) ______ surface. Shut-in head after ______ (hrs., mins.)
Date Mar 16, 1983

Total Depth 118 ft. Interval Logged 6 ft. to 118 ft.

Fluid in hole: Dry Characteristics ______
Fluid level ______ ft. Fluid Temperature ___ °F.
Date ______ Date ______

Water: Temperature ___ °F. at ______. Field Cond. ___
Ra(uu c/L ___ Beta-Gamma (uu c/L ___ U(10-3 gr/l ___

Logging Data

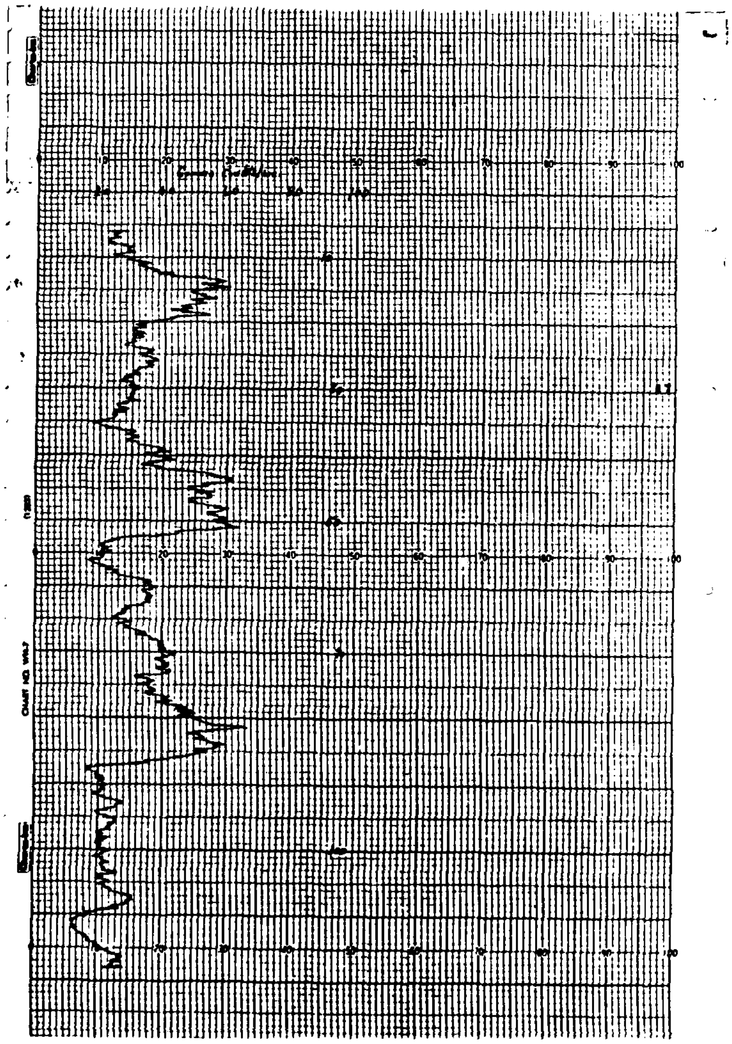
Run No. 1 of 1 runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ___
Logged out: 20 ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 1.0 Time constant 2

Statistical Variation ___ in. at ___ ft. Meter Reading ______ G-R Scale ______ Time Constant ______

Calibration in hole: (G-R Scale ______ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks ______

Radiation Intensity Increase → Depth Scale: 20 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field no. CN-9 Cup of Gas
Project Name Caballo Mtns
U.S.G.S. No. ________ Town ________
State NM County or Parish Sierra
Location ________
__¼__¼__¼__¼ Sec.____ T____ N S R____ E W

Depth Datum: ________, which is ________ ft. (above, below) land surface.
Altitude: MP ________ ft. Land surface 4732 ft.
Determined by ________
Operator(s) Hudson - Sanders
Equipment ________ Date ________
Equipment No.: ________ Vehicle No. ________

HOLE LOGGING DATA

Casing: Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.

Bore: Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.

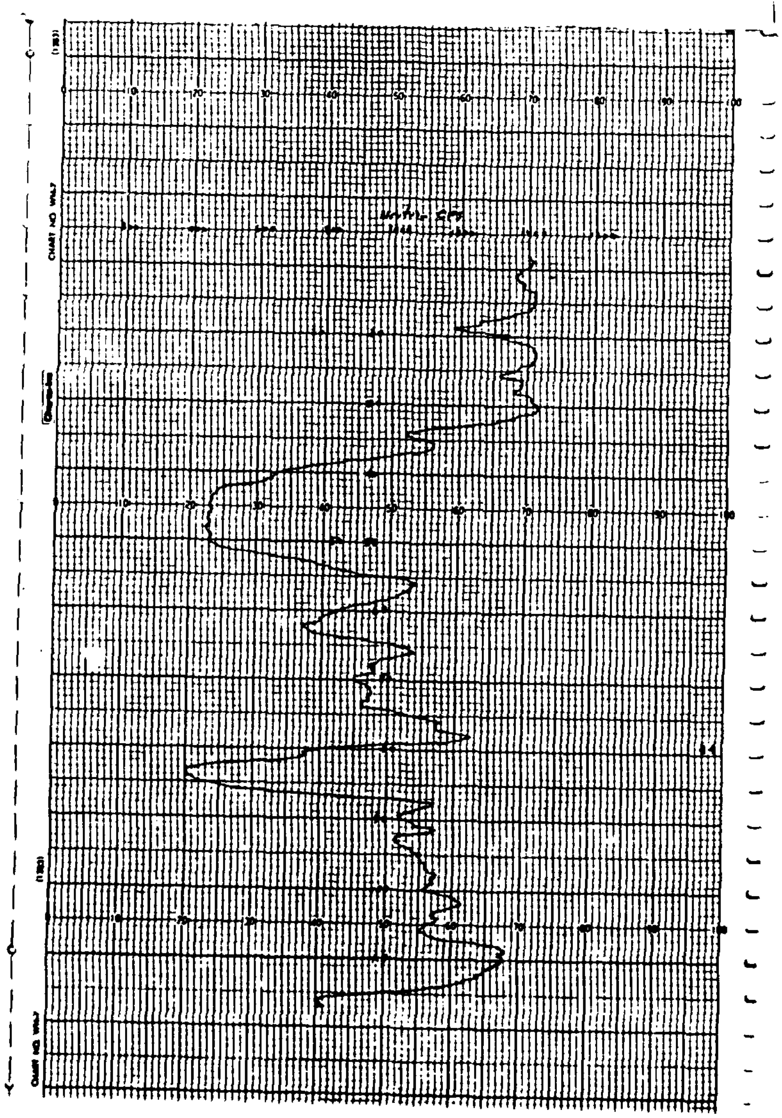
Water Level ____ ft. (above, below) ________
________, which is ____ ft. (above, below) surface. Shut-in head after ________ (hrs., mins.)
Date ________
Depth drilled (feet): ________
Depth Measured (feet): 112
Interval logged: ________ ft. to ________ ft.

FLUID DATA

Type: ________
Density, lbs./gal. ________
Viscosity, sec. ________
Resistivity, ohms: ________
Resistivity, B.H.T., ohms: ________ pH: ________
Circ. Temp.: ________ B.H. Temp.: ________
Remarks: Porosity formation measure left

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 curries AM-BE Spacers 17 in.
Hors. Scale 1K T.C. 2 sec.
Sens. Scale 1.0 Base Scale 1.0



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or Field No. CM-7 [illegible]

Project name Cuchillo Negro

Geological Survey No. ______

State NM County Sierra

Location ______

___ ¼ ___ ¼ ___ ¼ ___ ¼ Sec. ___ T ___ N/S R ___ E/W

Depth Datum: ______

which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface 4752 ft

Determined by ______

Operator(s) Hudson - Dewees

Equipment (Vehicle No.) ______ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics, ______
______ ft, to ______ ______
______ ft, to ______ ______

Perforations, Screen: Type, size ______
______ ft, to ______
______ ft, to ______

Water Level ______ ft. (above, below) ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date Aug 16, 1983

Total Depth 117 ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole: ______ Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______

Water: Temperature ______ °F. at ______. Field Cond. ______
Below c/l ______ Beta-Gamma (w. c/l ______ U(10-3 gr/l ______

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High

Descent: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ______

Logged out: 20 ft./min. Gamma-Ray circuit scale 10 D/50
Potential circuit scale 1.0 Time constant 2

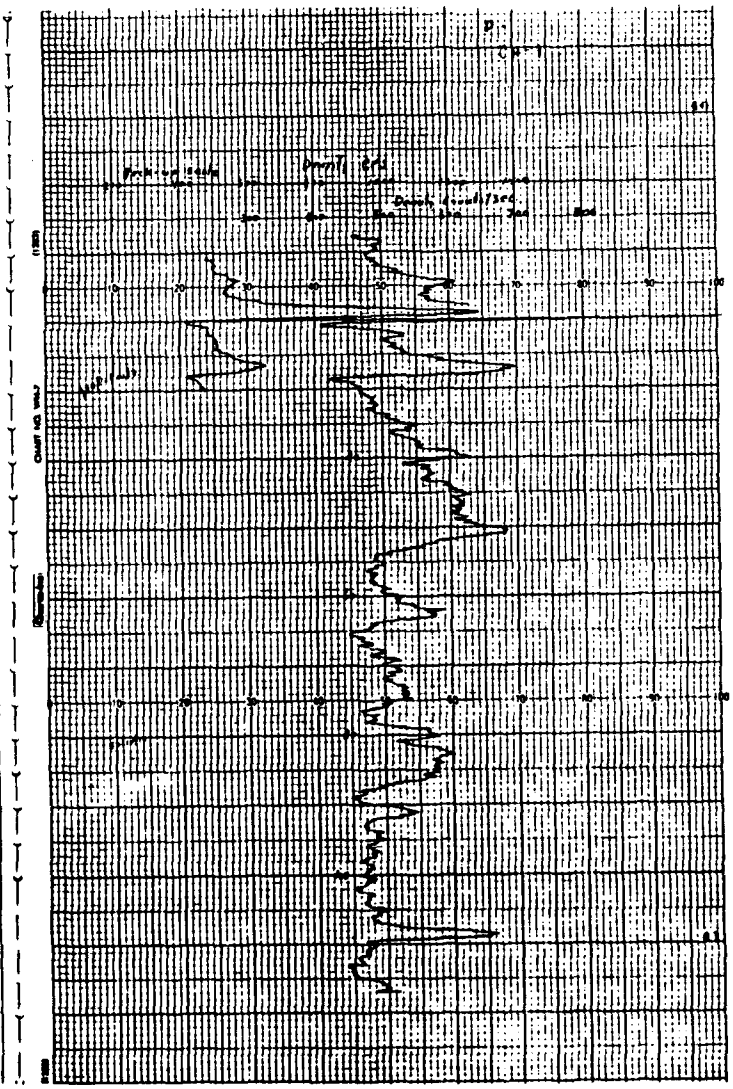
Statistical Variation ______ in. at ______ ft. Meter Reading ______ G-R Scale ______ Time Constant ______

Calibration in hole: (G-R Scale ______ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Density increases left

Remarks ______

Radiation Intensity Increase → Depth Scale: 1 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-9 Dept of Eng
Project Name Cuchillo Negro
U.S.G.S. No. ______ Town ______
State NM County or Parish Sierra
Location ______
___¼___¼___¼___¼ Sec.___ T.___ N/S R.___ E/W
Depth Datum: ______, which is ______ ft. (above, below) land surface.
Altitude: MP __ ft. Land surface 4732 ft.
Determined by ______
Operator(s) Hudson-Dewees
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______ ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

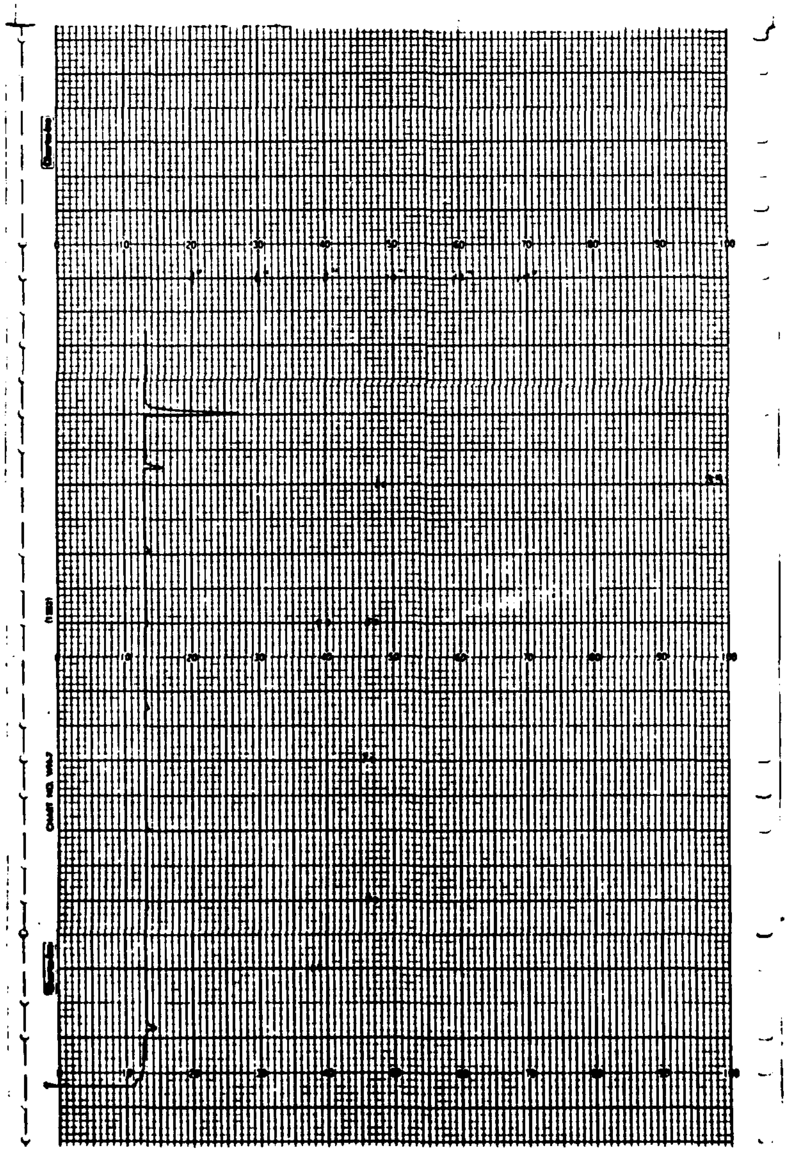
Date May 16, 1988
Depth drilled (feet) ______
Depth measured (feet) 118
Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: ______

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 20 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: TWO in./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA LOG

Owner or Field No. [illegible]
Project Name Cuchillo Negro
Geological Survey No. ______
State NM County Sierra
Location ______
____¼____¼____¼____¼ Sec. ____T____R____
Depth Datum: ______,
which is ______ ft. (above, below) land surface.
Altitude. MP ______ ft. Land surface 4718 ft
Determined by ______
Operator(s) Hudson - Dexter
Equipment (Vehicle No.) ______ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics, ______
______ ft, to ______
______ ft, to ______

Perforations, Screen: Type, size ______
______ ft, to ______
______ ft, to ______

Water Level ______ ft. (above, below) ______, which is ______ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date May 19 1981

Total Depth ______ ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole: Dry Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______
Water: Temperature ______ °F. at ______. Field Cond. ______
Ra(uu c/L ______ Beta-Gamma (uu c/L ______ U(10-3 gr/l ______

Logging Data

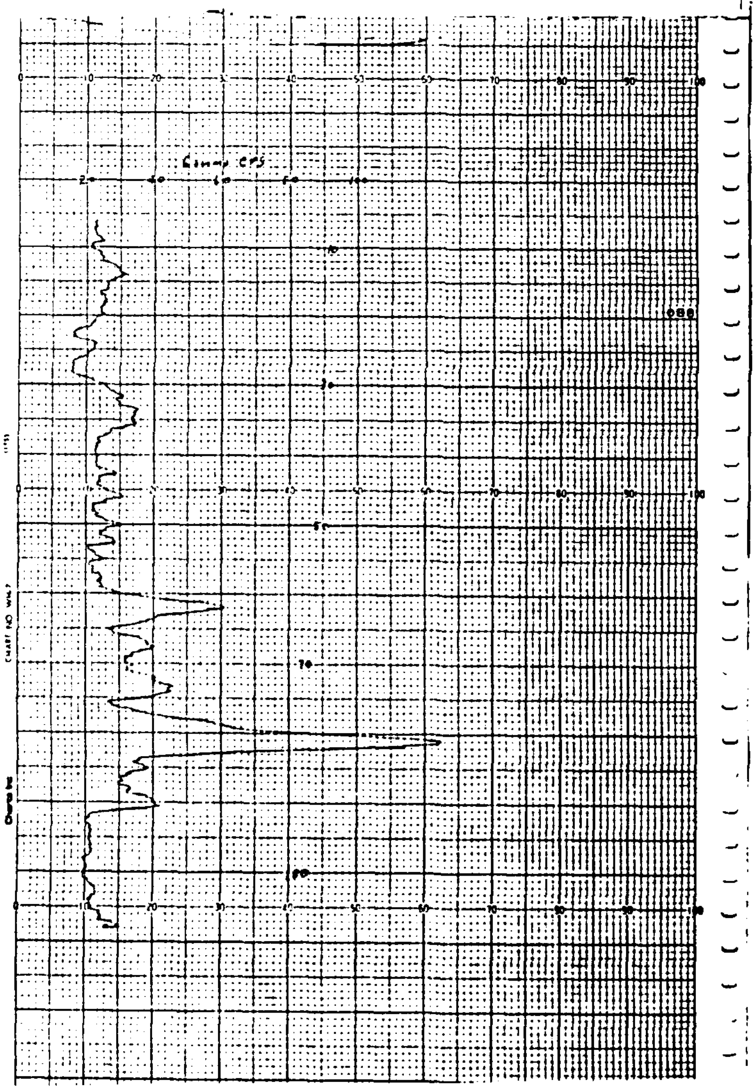
Run No. ___ of ___ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant 10
Logged out: 20 ft./min. Gamma-Ray circuit scale ______
Potential circuit scale 10 Time constant 2

Statistical Variation ______ in. at ______ ft. Meter
Reading ______ G-R Scale ______ Time Constant ______

Calibration in hole: (G-R Scale ______ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks ______

Radiation Intensity Increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CH-11 Corp of Eng
Project Name Cuchillo Negro
U.S.G.S. No. ______ Town ______
State NM County or Parish Sierra
Location ______
___ ¼ ___ ¼ ___ ¼ ___ ¼ Sec. ___ T ___ N/S R ___ E/W

Depth Datum: ______, which
is ______ ft. (above, below) land surface.
Altitude: MP ______ ft. Land surface ______ ft.
Determined by ______
Operator(s) Hudson-Powers
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

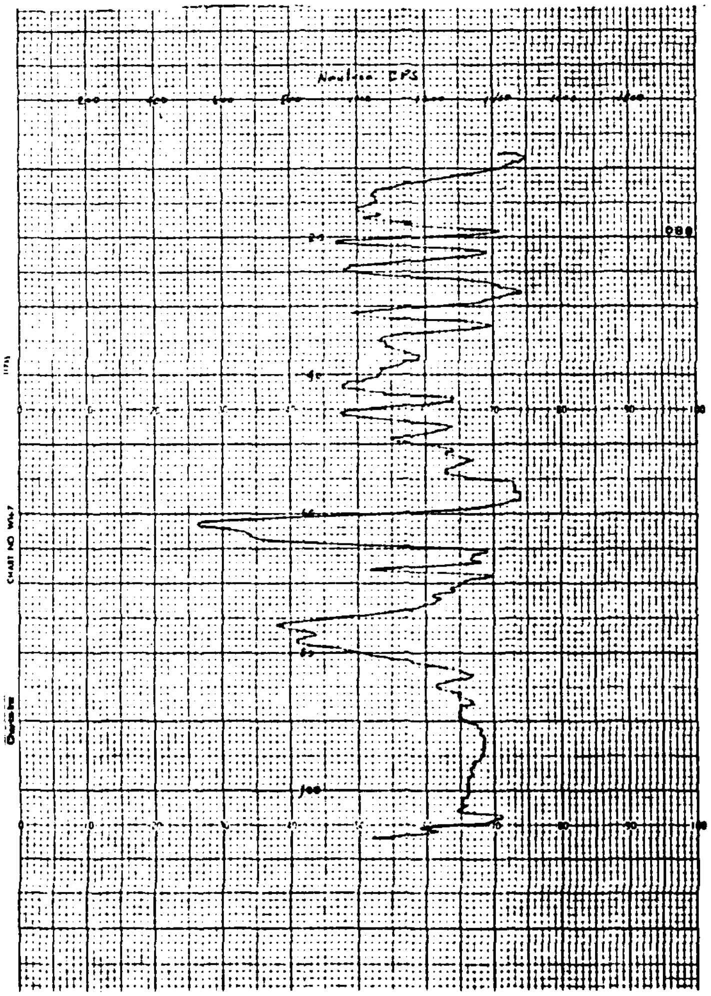
Water Level ______ ft. (above, below) ______
______, which is ______ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date May 19, 1982
Depth drilled (feet): ______
Depth Measured (feet): 108
Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 curries AM-BE Spacers 17 in.
Hors. Scale 1K T.C. 2 sec.
Sens. Scale 10 Base Scale 100

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: Porosity [illegible] incr. left



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or field no. _____________

Project name Cuchillo Negro

Geological Survey No. _____________

State N.M. County Sierra

Location _____________

Sec. _____________

Depth Datum: _____________

which is _____ ft. (above, below) land surface.

Altitude MP _____ ft. Land surface 4718 ft

Determined by _____________

Operator(s) Hudson - Dawes

Equipment (vehicle no.) _____________ Date _____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type _____ Thickness _____ Characteristics,
_____ ft, to _____
_____ ft, to _____

Perforations, Screen: Type, size _____
_____ ft, to _____
_____ ft, to _____

Water Level _____ ft. (above, below) _____, which is ___ ft. (above, below) surface. Shut-in head after _____ (hrs., mins.)
Date May 19 1958

Total Depth 108 ft. Interval Logged _____ ft. to _____ ft.

Fluid in hole: Dry Characteristics _____
Fluid level _____ ft. Fluid Temperature _____ °F.
Date _____ Date _____

Water: Temperature _____ °F. at _____. Field Cond. _____
Ra(uu c/L _____ Beta-Gamma (uu c/L _____ U(10-3 gr/l _____

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High

Descent ___ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale _____ Time constant ___

Logged out. _____ ft./min. Gamma-Ray circuit scale _____
Potential circuit scale 10 Time constant _____

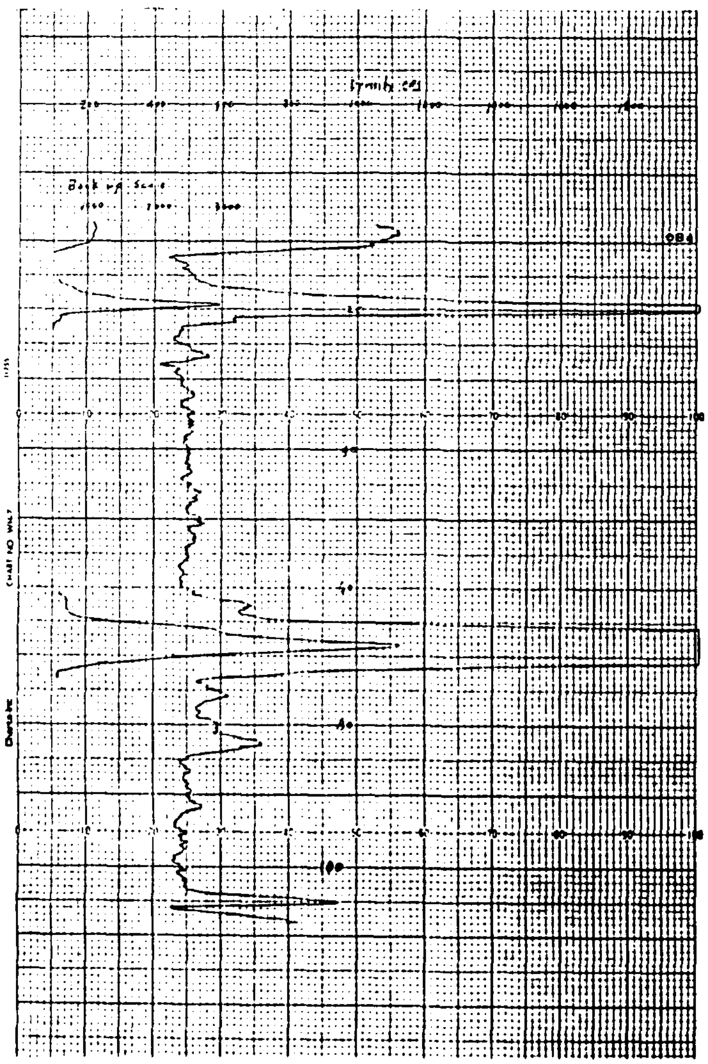
Statistical Variation _____ in. at _____ ft. Meter Reading _____ G-R Scale _____ Time Constant _____

Calibration in hole: (G-R Scale _____ Pot. circ. scale ___)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks _____________

Radiation Intensity Increase → Depth Scale 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. *CH-11 Corps of Eng.*

Project Name *Cuchillo Negro*

U.S.G.S. No. ______ Town ______

State *NM* ______ County or Parish *Sierra*

Location ______

___¼___¼___¼___¼ Sec.___ T.___ N/S R.___ E/W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude: MP ___ ft. Land surface ______ ft.

Determined by ______

Operator(s) *Hudson - Dewees*

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing. Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______
______, which is ___ ft. (above, below)
surface. Shut-in head after ______ (hrs., mins.)

Date *May 19, 1977*

Depth drilled (feet) ______

Depth measured (feet) *108*

Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type: ______

Density, lbs./gal. ______

Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

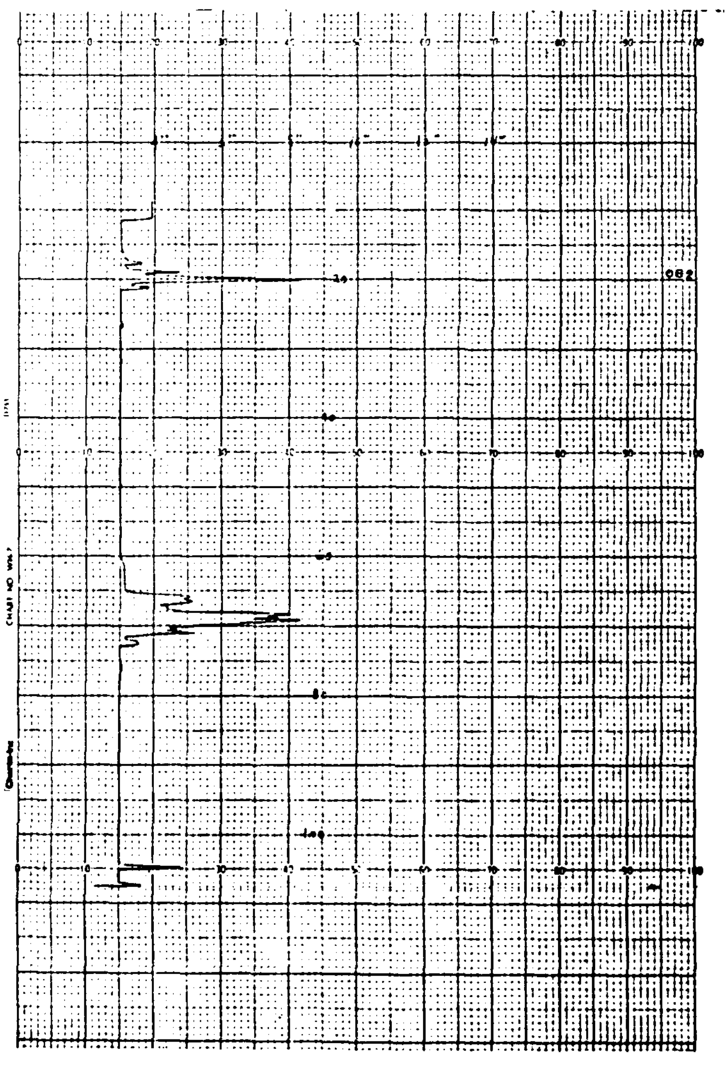
Remarks: ______

OPERATION DATA

Run No. *1* of *1* runs. Logging speed. *15* ft./min.

Vertical scale: *10* ft./in.

Horizontal scale: *Two* in./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Project name Cuchillo Negro

Geological Survey No. ____

State NM County Sierra

Location ____

___¼ ___¼ ___¼ ___¼ Sec. ___ T. ___ R. ___

Depth Datum ____, which is ____ ft. (above, below) land surface.

Altitude: MP ____ ft. Land surface ____ ft

Determined by ____

Operator(s) Hudson, Dwyers

Equipment (vehicle No.) ____ Date ____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore. Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter Type ____ Thickness ____ Characteristics.
____ ft. to ____ ____
____ ft. to ____ ____

Perforations, Screen: Type, size ____
____ ft. to ____
____ ft. to ____

Water Level ____ ft. (above, below) ____, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)

Date Nov. 19, 1978

Total Depth 27 ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____

Fluid level ____ ft. Fluid Temperature ____ °F.

Date ____ Date ____

Water: Temperature ____ °F. at ____. Field Cond. ____

Below c/L ____ Beta-Gamma (uu c/L ____ U(10-3 gr/l ____

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High

Descent: ___ ft./min. Gamma-Ray circuit scale ____

Potential circuit scale ____ Time constant ____

Logged out: ____ ft./min. Gamma-Ray circuit scale 100

Potential circuit scale 10 Time constant 2

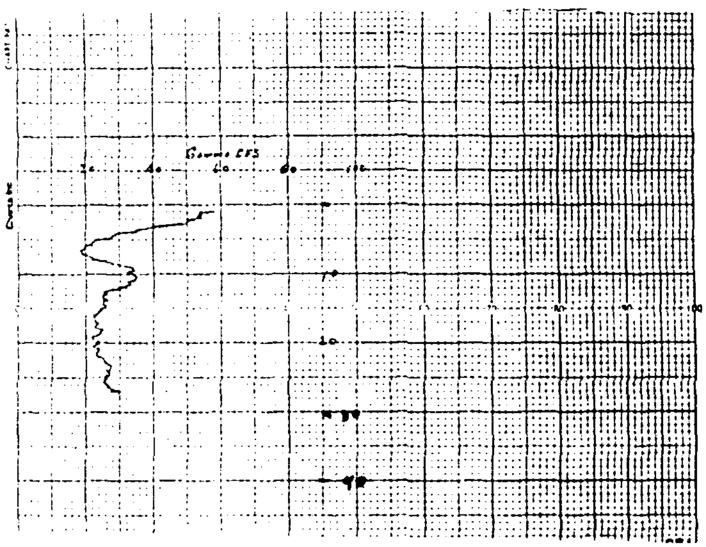
Statistical variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ____)

Depth (ft.) Obs. Time (min.) Meter Reading

Remarks No log made in this hole

Radiation Intensity Increase → Depth Scale: 10 ft./in.



Owner or Field No. [illegible]
Project name Cuchillo Negro
Geological Survey No. ______
State N M County Sierra
Location ______
____¼____¼____¼____¼ Sec. ____T.____ R.____
Depth Datum ______,
which is ______ ft. (above, below) land surface.
Altitude, MP ______ ft. Land surface 4722 ft.
Determined by ______
Operator(s) Hudson - Drewes
Equipment (Vehicle No.) ______ Date ______

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter. Type ______ Thickness ______ Characteristics,
______ ft, to ______ ______
______ ft, to ______ ______

Perforations, Screen: Type, size ______
______ ft, to ______
______ ft, to ______

Water Level ______ ft. (above, below) ______
______, which is ____ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date May 19, 19[illegible]

Total Depth 69 ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole: ______ Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______

Water: Temperature ______ °F. at ______. Field Cond. ______
Ra(uu c/l ______ Beta-Gamma (uu c/l ______ U(10-3 gr/l ______

Logging Data

Run No. ____ of ____ runs. Probe Sensitivity (High
Descent. ____ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ____
Logged out. ____ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 10 Time constant 2

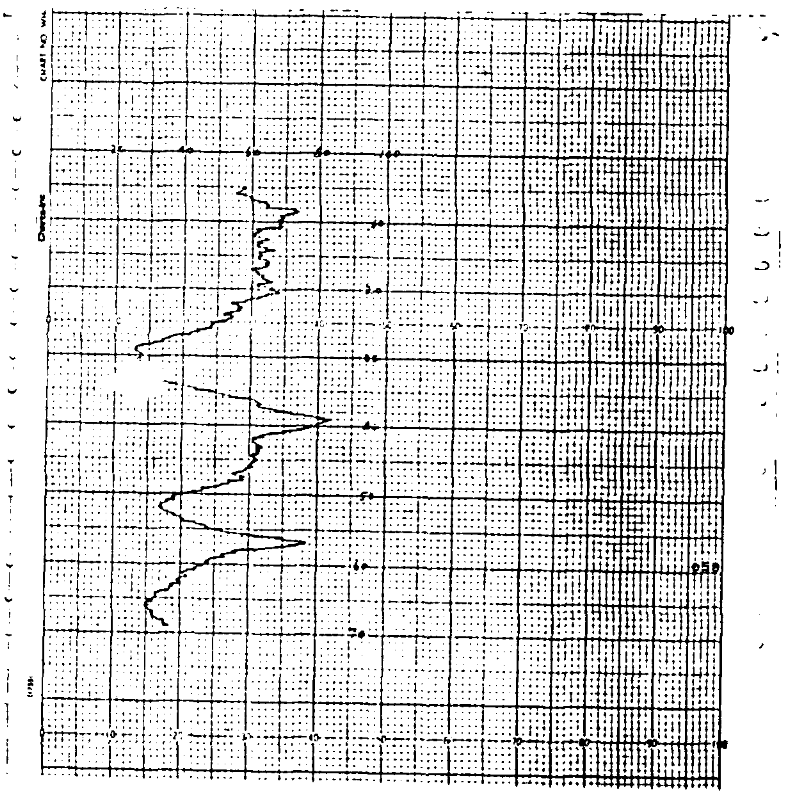
Statistical Variation ______ in. at ______ ft. Meter Reading ______ G-R Scale ______ Time Constant ______

Calibration in hole: (G-R Scale ______ Pot. circ. scale ____)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks ______

Radiation Intensity Increase ——→ Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CM-12 Corps of Eng

Project Name Caballo Negro

U.S.G.S No. ______ Town ______

State NM County or Parish Sierra

Location ______

___¼___¼___¼___¼ Sec.____ T.____ S R.____ E/W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface ______ ft.

Determined by ______

Operator(s) Hudson-Powers

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______ ______, which is ______ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date ______

Depth drilled (feet): ______

Depth Measured (feet): 68

Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 15 ft./min.

Vertical Scale 10 ft /in.

Source 3 curries AM-BE Spacers 17 in.

Horz. Scale 1K T.C 2 sec.

Sens. Scale 1.0 Base Scale 10.0

FLUID DATA

Type: ______

Density, lbs./gal. ______

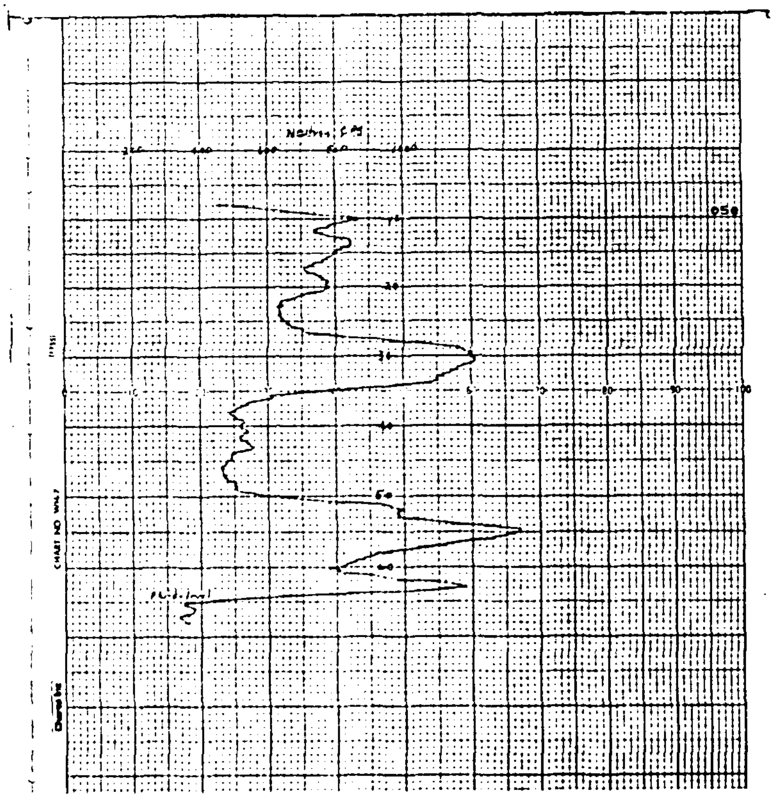
Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

Remarks: Porosity Increases over left



[illegible]

Project name [illegible]

Geological Survey No. ____

State N.M. County Sierra

Location ____

__¼__¼__¼__¼ Sec. ___ T. ___ N/S R. ___ E/W

Depth Datum: ____

which is ____ ft. (above, below) land surface.

Altitude MP ____ ft. Land surface ____ ft

Determined by ____

Operator(s) Hudson · Dewees

Equipment (vehicle No.) ____ Date ____

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Casing Data

Casing. Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore. Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter. Type ____ Thickness ____ Characteristics,
____ ft. to ____ ____
____ ft. to ____ ____

Perforations, Screen. Type, size ____
____ ft. to ____
____ ft. to ____

Water Level ____ ft. (above, below) ____
____, which is ___ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date May [illegible]

Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F.
Date ____ Date ____

Water Temperature ____ °F. at ____. Field Cond. ____
Raluu c/t ____ Beta-Gamma (uu c/t ____ U(10-3 gr/l ____

Logging Data

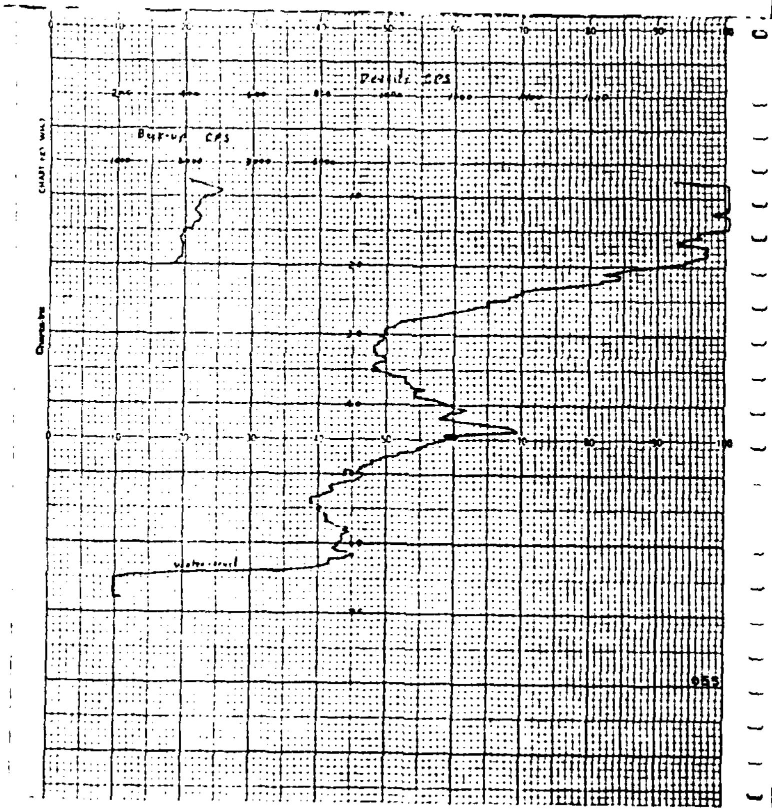
Run No. ___ of ___ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale ____ Time constant ____
Logged out: ____ ft./min. Gamma-Ray circuit scale [illegible]
Potential circuit scale 10 Time constant 3

Statistical Variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks [illegible] left

Radiation intensity increase → Depth Scale 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-13 Corp of Eng
Project Name Caballo Negro
U.S.G.S. No. ______ Town ______
State NM County or Parish Sierra
Location ______
___¼ ___¼ ___¼ ___¼ Sec. ___ T ___ N/S R ___ E/W
Depth Datum: ______, which is ______ ft. (above, below) land surface.
Altitude: MP ___ ft. Land surface ______ ft.
Determined by ______
Operator(s) Hudson Dewees
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

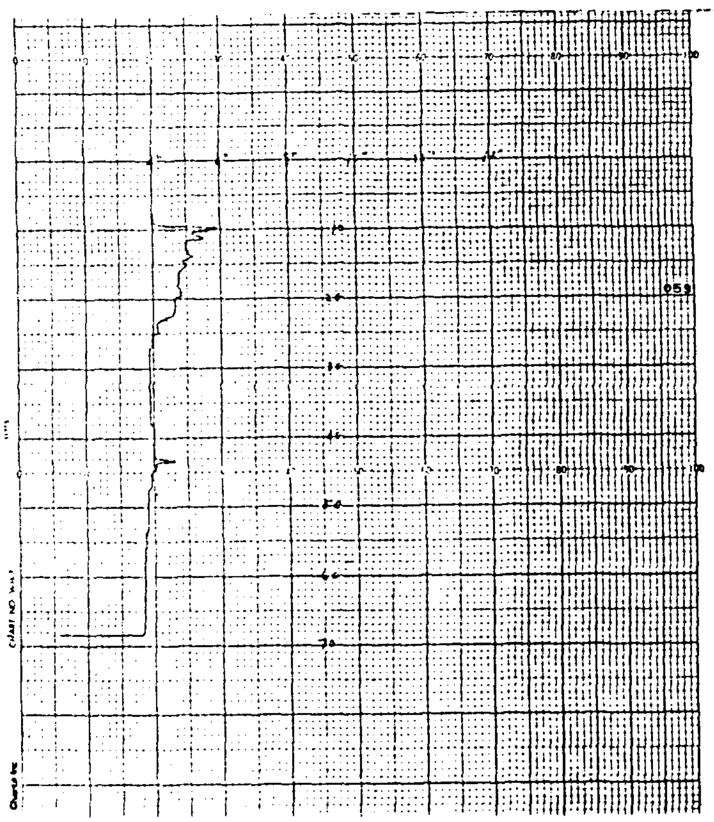
Water Level ______ ft. (above, below) ______ ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date ______
Depth drilled (feet) ______
Depth measured (feet) 68.5
Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type. ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: ______

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: Two in./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Geological Survey No. AH-13 Corp of Eng
State Nev County Seneca
Location ____
__¼__¼__¼__¼ Sec. ___T.___ R.___
Depth Datum: ____
which is ____ ft. (above, below) land surface.
Altitude: MP ____ ft. Land surface 4705 ft
Determined by ____
Operator(s) Hudson - Dewees
Equipment (Vehicle No.) ____ Date ____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ____ Thickness ____ Characteristics,
____ ft, to ____ ____
____ ft, to ____ ____

Perforations, Screen: Type, size ____
____ ft, to ____
____ ft, to ____

Water Level ____ ft. (above, below) ____ , which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date May 18, 1958

Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F.
Date ____ Date ____

Water: Temperature ____ °F. at ____. Field Cond. ____
Ra(uu c/L ____ Beta-Gamma (uu c/L ____ U(10-3 gr/l ____

Logging Data

Run No. ____ or ____ runs. Probe Sensitivity (High
Descent: ____ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale ____ Time constant ____
Logged out: ____ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 1.0 Time constant 2

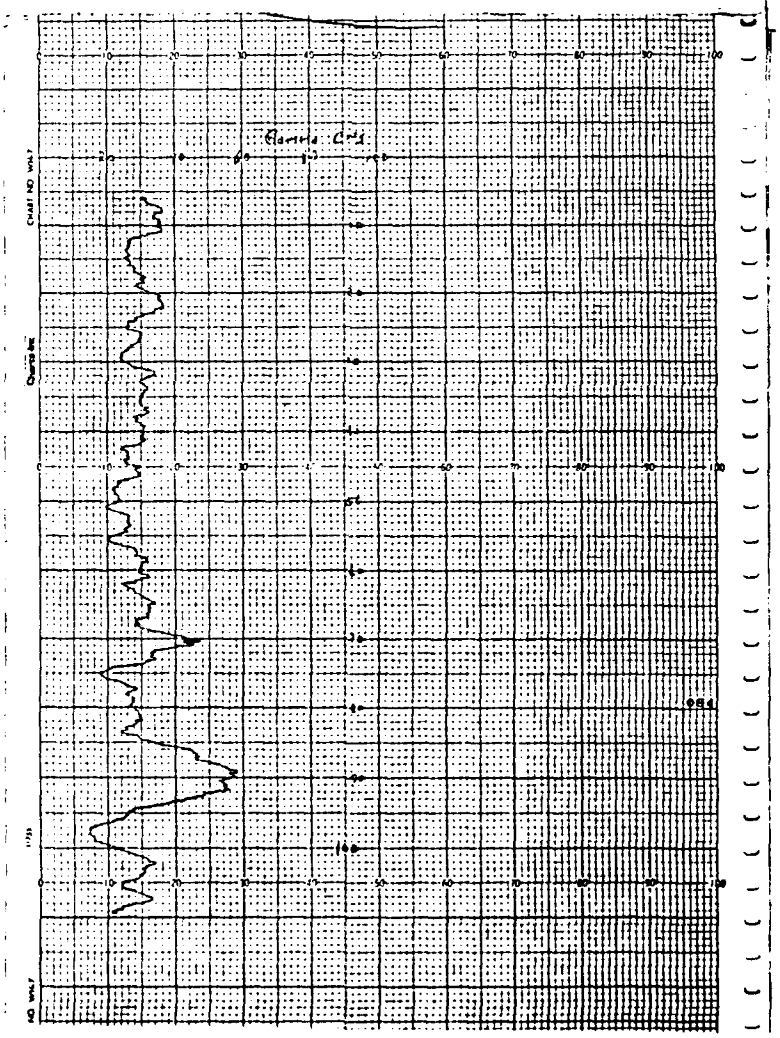
Statistical Variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ____)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks ____

Radiation Intensity Increase →   Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CH-13 Corp of Eng
Project Name Caballo [illegible]
U.S.G.S. No. ______ Town ______
State N M ______ County or Parish Sierra
Location ______
___¼___¼___¼___¼ Sec.___ T.___ N S ___ E W
Depth Datum: ______, which
is ______ ft. (above, below) land surface.
Altitude: MP ______ ft. Land surface 4705 ft.
Determined by ______
Operator(s) Hudson - [illegible]
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam.______in.______ft. to ______ft.
Diam.______in.______ft. to ______ft.
Diam.______in.______ft. to ______ft.

Bore: Diam.______in.______ft. to ______ft.
Diam.______in.______ft. to ______ft.
Diam.______in.______ft. to ______ft.

Water Level______ft. (above,below) ______
______, which is______ft. (above,below)
surface. Shut-in head after ______(hrs.,mins.)

Date Aug 18, 1987

Depth drilled (feet): ______

Depth Measured (feet): 113

Interval logged: ______ft. to ______ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.

Vertical Scale 10 ft./in.

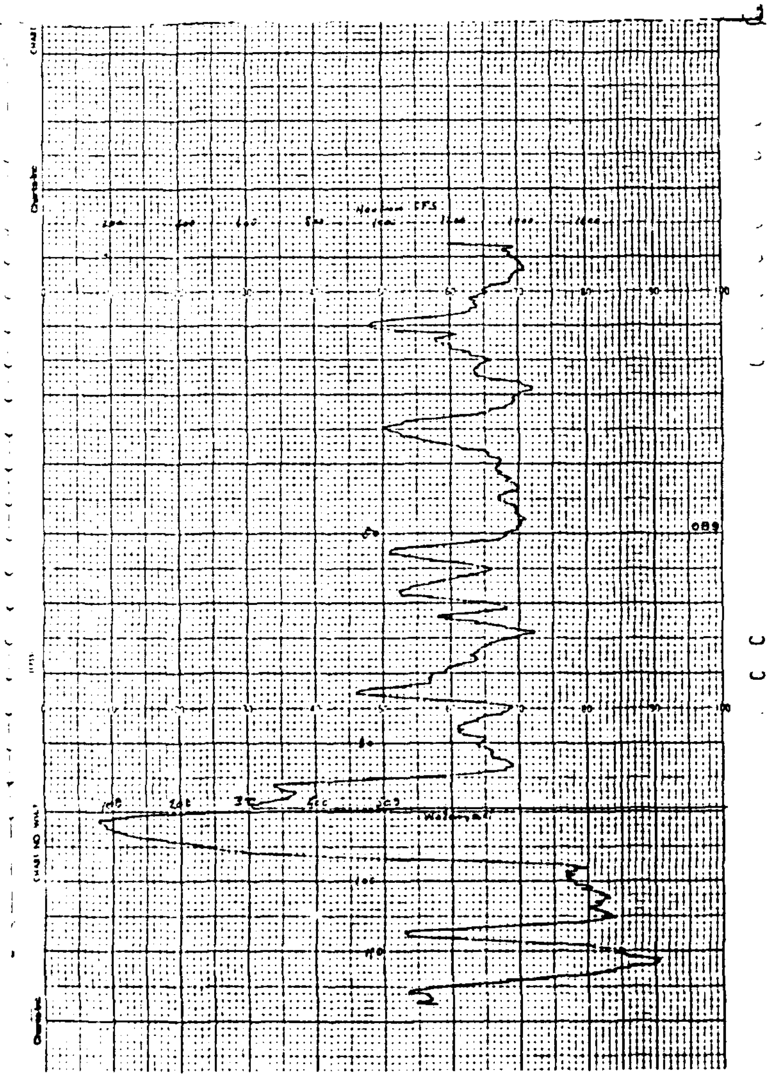
Source 3 curies AM-BE Spacers 17 in.

Hors. Scale [illegible] T.C. 2 sec.

Sens. Scale 1.0 Base Scale 10.0

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: Porosity Increase max. left
Note scale change at fluid level



Owner or Field No. ____
Project Name Carlile Mag-0
Geological Survey No. ____
State Utah County Sevier
Location ____
____ ¼ ____ ¼ ____ ¼ ____ ¼ Sec. ____ T. ____ N/S R. ____ E/W

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Depth Datum ____
which is ____ ft. (above, below) land surface.
Altitude MP ____ ft. Land surface 4705 ft
Determined by ____
Operator(s) ____ Deakes
Equipment (Vehicle No.) ____ Date ____

Casing Data

Casing. Diam. ____ in. ____ ft. to ____ ft. Thickness ____ in.
Diam. ____ in. ____ ft. to ____ ft. Thickness ____ in.
Diam. ____ in. ____ ft. to ____ ft. Thickness ____ in.

Bore. Diam. ____ in. ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.

Filter: Type ____ Thickness ____ Characteristics.
____ ft, to ____
____ ft, to ____

Perforations, Screen: Type, size ____
____ ft, to ____
____ ft, to ____

Water Level 91 ft. (above, below) land surface, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date ____

Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F.
Date ____ Date ____

Water: Temperature ____ °F. at ____. Field Cond. ____
Ra (uu c/l ____ Beta-Gamma (uu c/l ____ U(10-3 gr/l ____

Logging Data

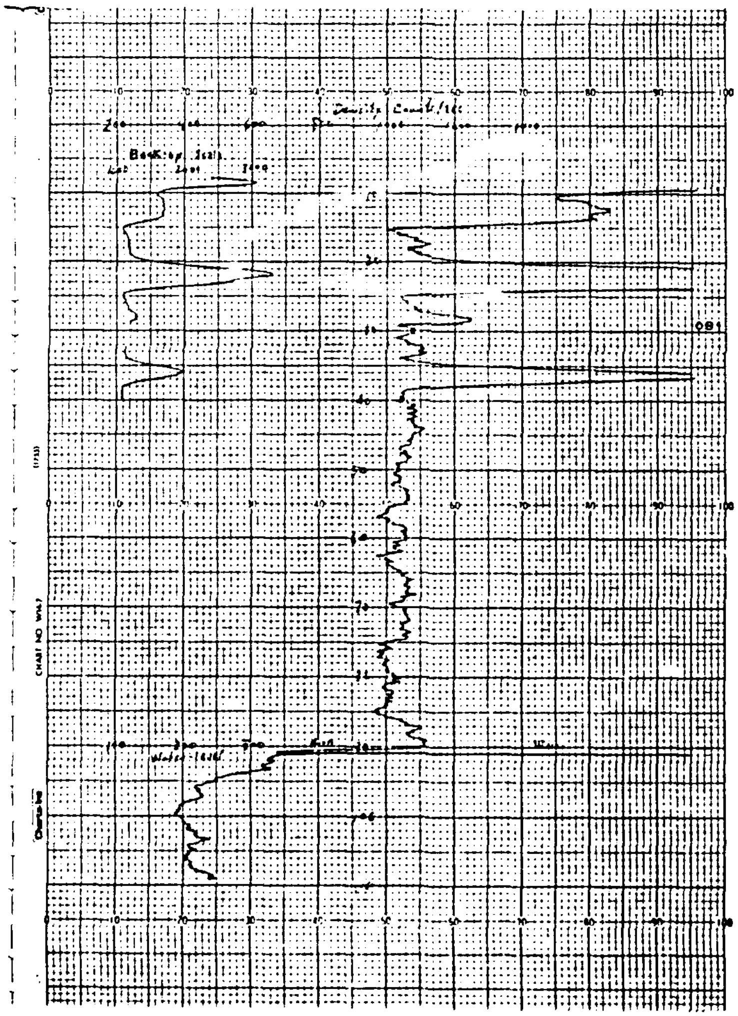
Run No. ____ of ____ runs. Probe Sensitivity (High
Descent: ____ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale ____ Time constant ____
Logged out: ____ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale 1.0 Time constant 2

Statistical variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ____)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks ____

Radiation Intensity Increase ⟶ Depth Scale: 10 ft./in.



Owner or field no. CH-18 Corps of Eng

Project name Cuchillo Negro

U.S.G.S. No. ________ Town ________

State NM County or Parish Sierra

Location ________

___¼___¼___¼___¼ Sec.___ T.___ N/S R.___ E/W

Depth Datum: ________, which is ______ ft. (above, below) land surface.

Altitude: MP ___ ft. Land surface 4705 ft.

Determined by ________

Operator(s) Hudson-Devlers

Equipment ________ Date ________

Equipment No.: ______ Vehicle No. ________

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

CALIPER LOG

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ________ ft. (above, below) ________ ________, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date ________

Depth drilled (feet) ________

Depth measured (feet) 118

Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type: ________

Density, lbs./gal. ________

Viscosity, sec. ________

Resistivity, ohms: ________

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

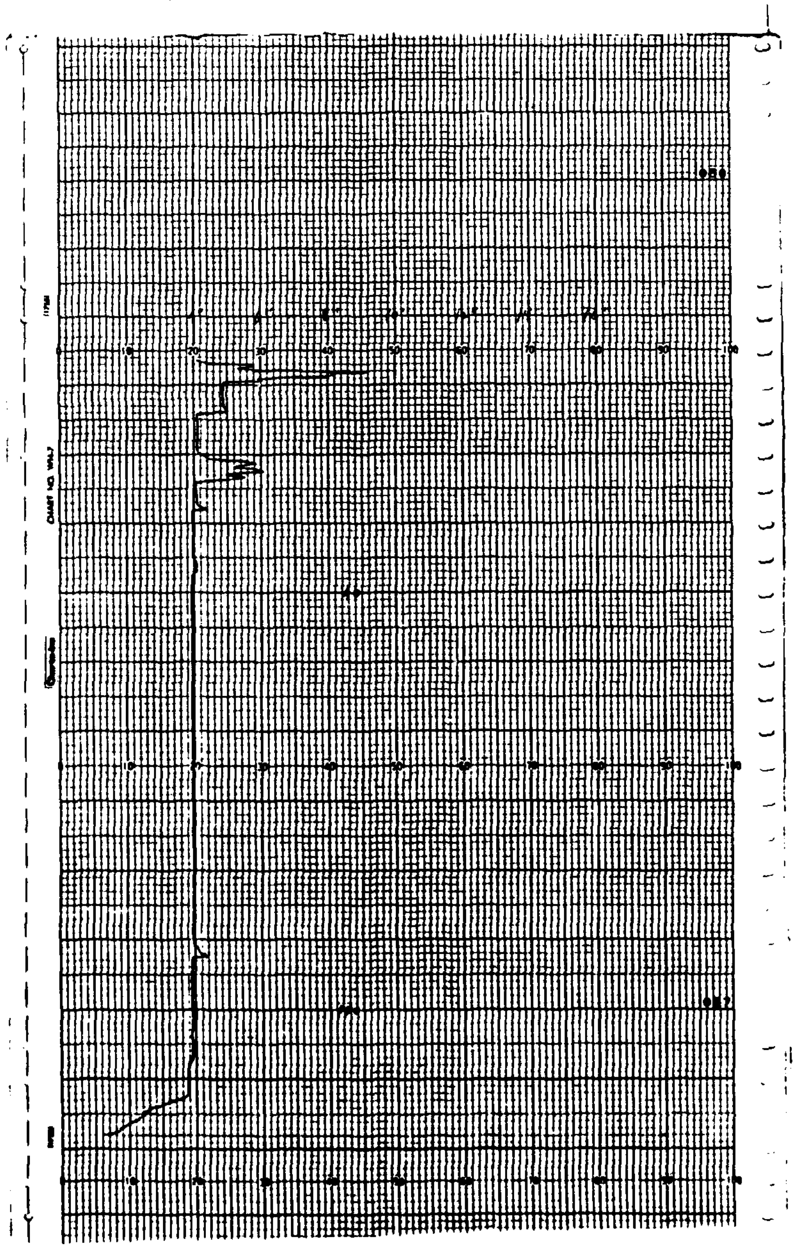
Remarks: ________

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.

Vertical scale: 10 ft./in.

Horizontal scale: Two in./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA LOG

Geological Survey No. CH-19 Corp. of Eng.
State NM County Sierra
Location Cuchillo Negro
¼ ¼ ¼ ¼ Sec. ___ T ___ N/S R ___ E/W
Depth Datum: ______
which is ______ ft. (above, below) land surface.
Altitude: MP ______ ft. Land surface 4650 ft
Determined by ______
Operator(s) Hudson - Dewers
Equipment (Vehicle No.) ______ Date ______

Casing Data

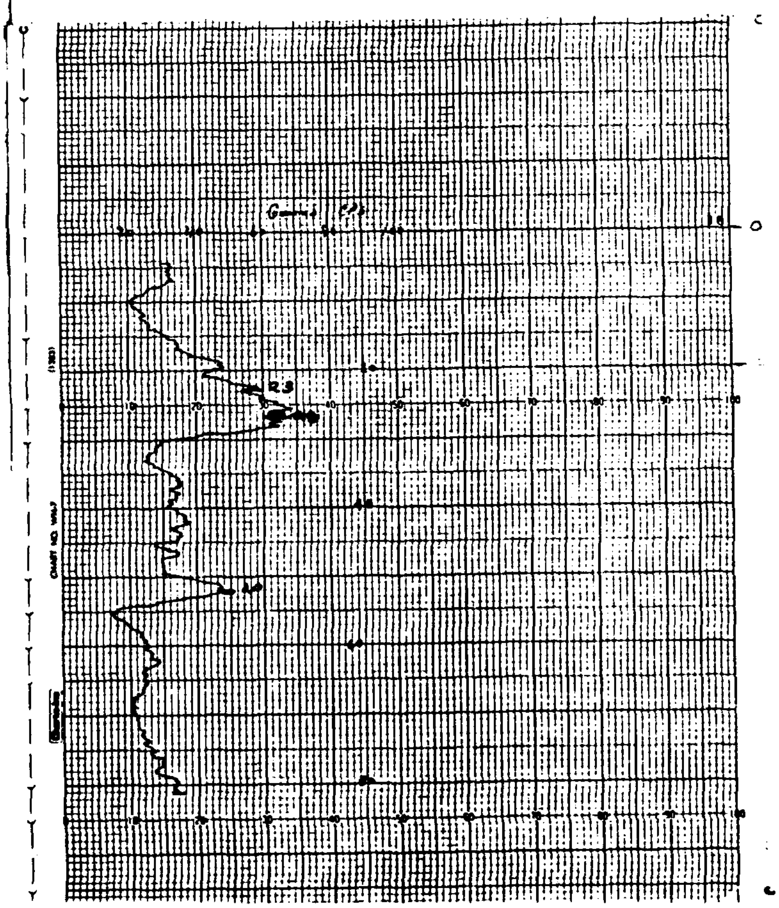
Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Filter: Type ______ Thickness ______ Characteristics, ______
______ ft. to ______
______ ft. to ______
Perforations, Screen: Type, size ______
______ ft. to ______
______ ft. to ______
Water Level ______ ft. (above, below) ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date May 17, 1988
Total Depth ______ ft. Interval Logged ______ ft. to ______ ft.
Fluid in hole: Dry Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______
Water: Temperature ______ °F. at ______. Field Cond. ______
Ra (uu c/L ___ Beta-Gamma (uu c/L ___ U(10-3 gr/l ______

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 10 Time constant 2
Logged out: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ______
Statistical Variation ______ in. at ______ ft. Meter Reading ______ G-R Scale ______ Time Constant ______
Calibration in hole: (G-R Scale ______ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks ______

Radiation Intensity Increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CH-19 Corp of Eng.

Project Name Cuchilla Negra

U.S.G.S. No. ______ Town ______

State N.M. County or Parish Sierra

Location ______

______ ¼ ¼ ¼ ¼ Sec. ____ T ____ N S R ____ E W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface 4630 ft.

Determined by ______

Operator(s) Hudson - Dewees

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______ , which is ______ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 11, 1978

Depth drilled (feet): ______

Depth Measured (feet): 81

Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.

Vertical Scale 10 ft./in.

Source 3 curries AM-BE Spacers 17 in.

Hora. Scale 1K T.C. 2 sec.

Sens. Scale 1.0 Base Scale 10

FLUID DATA

Type: ______

Density, lbs./gal. ______

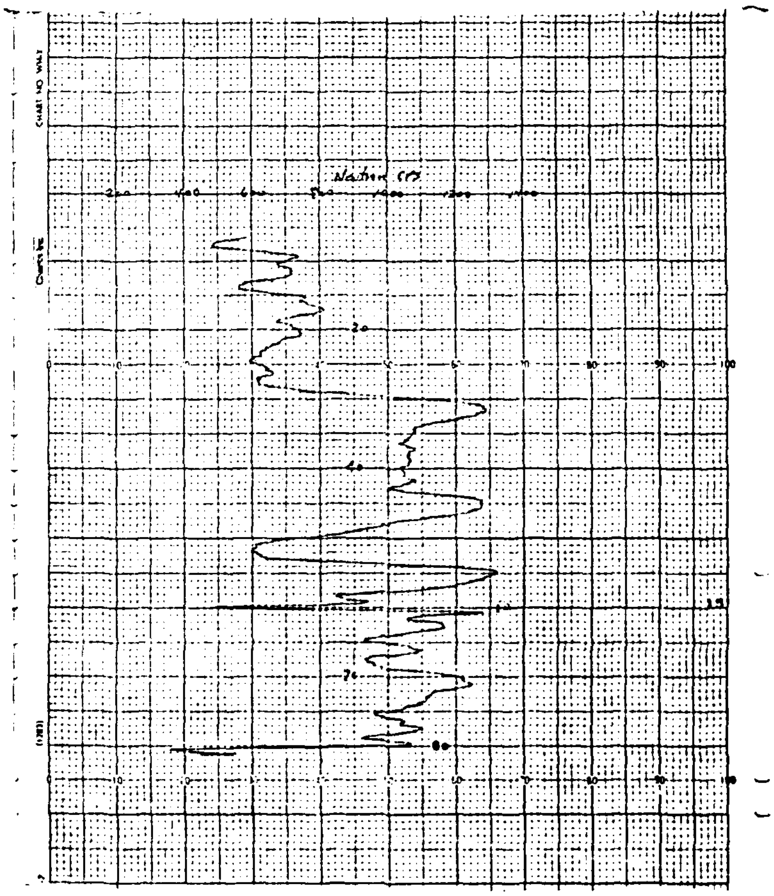
Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

Remarks: ______



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or Field No. CH-19 Corp of Eng

Project name Cochiti Mesa

Geological Survey No. ____

State NM County Sierra

Location ____

____ ____ ____ ____ Sec. ____ T ____ R ____

Depth Datum: ____

which is ____ ft. (above, below) land surface.

Altitude: MP ____ ft. Land surface 4630 ft

Determined by ____

Operator(s) Hudson-Dexter

Equipment (Vehicle No.) ____ Date ____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore. Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ____ Thickness ____ Characteristics, ____ ft, to ____ ____ ft, to ____

Perforations, Screen: Type, size ____ ____ ft, to ____ ____ ft, to ____

Water Level ____ ft. (above, below) ____, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)

Date May 17, 197?

Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____

Fluid level ____ ft. Fluid Temperature ____ °F.

Date ____ Date ____

Water. Temperature ____ °F. at ____. Field Cond. ____

Ra(uu c/L ____ Beta-Gamma (uu c/L ____ U(10-3 gr/l ____

Logging Data

Run No. ____ of ____ runs. Probe Sensitivity (High

Descent: ____ ft./min. Gamma-Ray circuit scale ____

Potential circuit scale ____ Time constant ____

Logged out: ____ ft./min. Gamma-Ray circuit scale ____

Potential circuit scale 1c Time constant ____

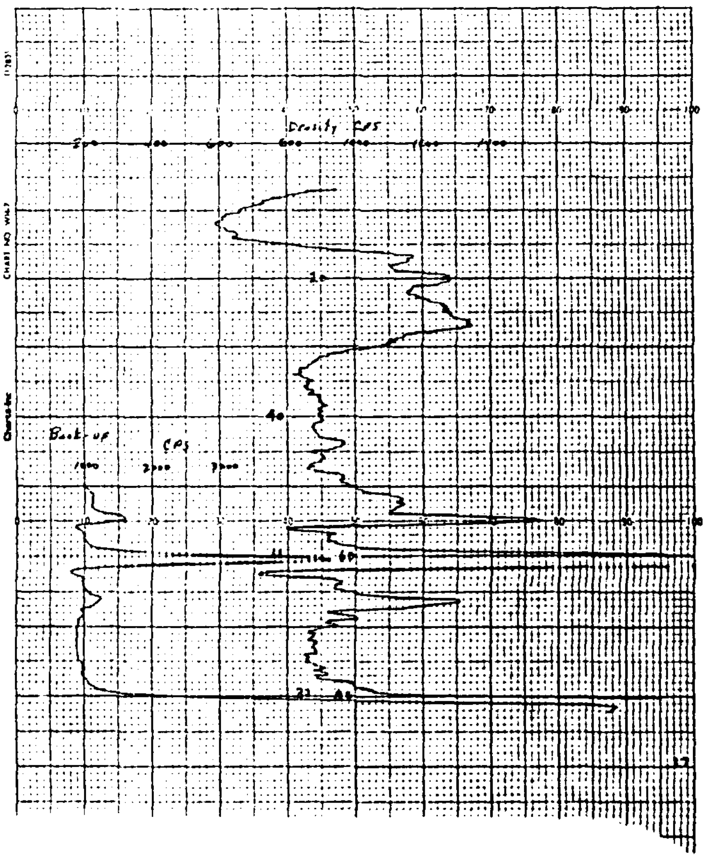
Statistical Variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ____)

Depth (ft.) Obs. Time (min.) Meter Reading

Remarks ____

Radiation Intensity Increase ____ > ____ Depth Scale: ____ 10 ____ ft./in.



Owner or Field No. CH-19 Corps of Eng.
Project name Cuchillo Negro
U.S.G.S. No. ______ Town ______
State NM County or Parish Sierra
Location ______
___¼___¼___¼___¼ Sec.___T.___N/S R.___E/W
Depth Datum: ______, which is ______ ft. (above, below) land surface.
Altitude: MP ___ ft. Land surface 4650 ft.
Determined by ______
Operator(s) Hudson - Dexter
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

CALIPER LOG

HOLE LOGGING DATA

Casing. Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______
______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

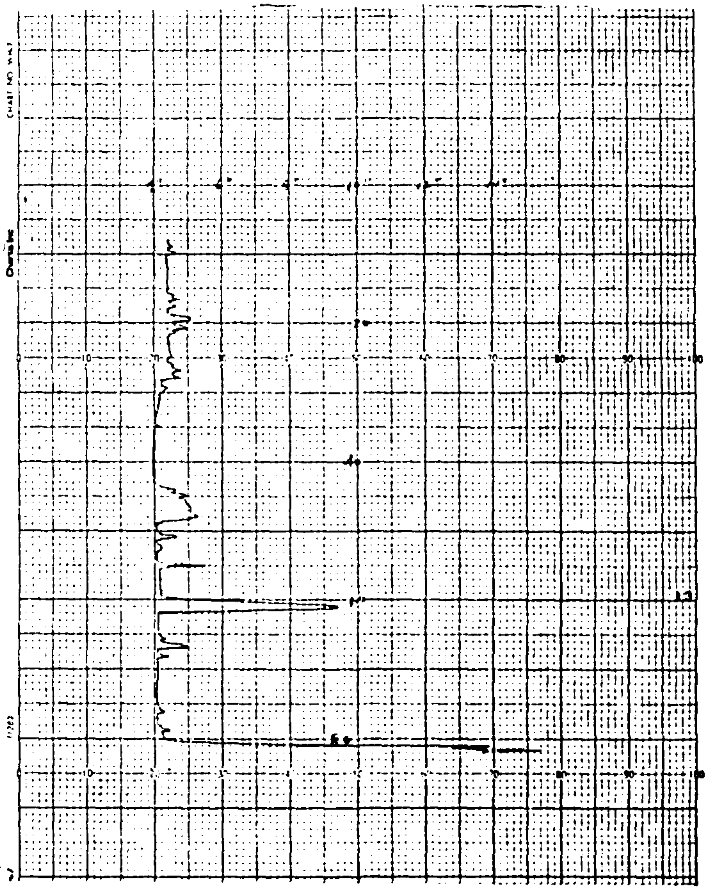
Date May 17, 1978
Depth drilled (feet) ______
Depth measured (feet) 82
Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: TWO in./in.

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: ______



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ___ Thickness ___ Characteristics,
___ ft, to ___ ___
___ ft, to ___ ___

Perforations, Screen: Type, size ___
___ ft, to ___
___ ft, to ___

Water Level ___ ft. (above, below) ___, which is ___ ft. (above, below) surface. Shut-in head after ___ (hrs., mins.)
Date May 17, 1981

Total Depth ___ ft. Interval Logged ___ ft. to ___ ft.

Fluid in hole. ___ Characteristics ___
Fluid level ___ ft. Fluid Temperature ___ °F.
Date ___ Date ___

Water: Temperature ___ °F. at ___. Field Cond. ___
Ra(uu c/L ___ Beta-Gamma (uu c/L ___ U(10-3 gr/l ___

Geological Survey No. CH-10 Corralitos
State N M County Sierra
Location Cuchillo Negro
___ ¼ ___ ¼ ___ ¼ ___ ¼ Sec. ___ T. ___ R. ___

Depth Datum: ___
which is ___ ft. (above, below) land surface.
Altitude. MP ___ ft. Land Surface 4662 ft
Determined by ___
Operator(s) Hudson · Dexter
Equipment (vehicle No.) ___ Date ___

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ___
Potential circuit scale ___ Time constant ___
Logged out ___ ft./min. Gamma-Ray circuit scale 10³
Potential circuit scale 1.0 Time constant 2

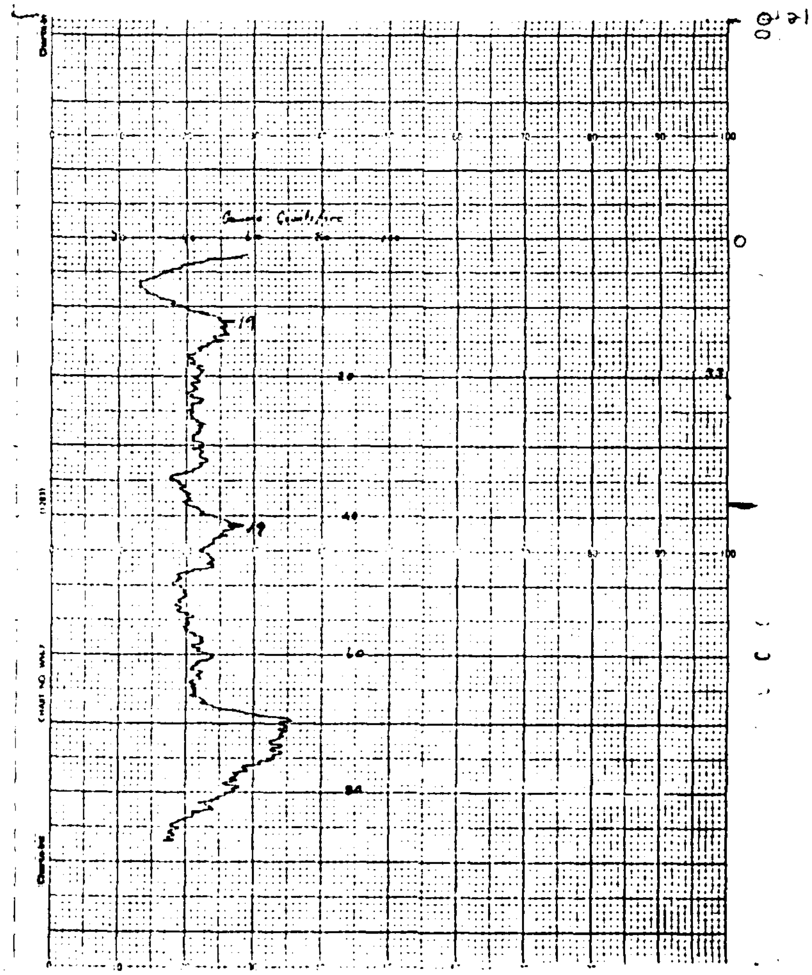
Statistical Variation ___ in. at ___ ft. Meter Reading ___ G-R Scale ___ Time Constant ___

Calibration in hole: (G-R Scale ___ Pot. circ. scale ___)

Depth (Ft.)	Obs. Time (min.)	Meter Reading

Remarks ___

Radiation Intensity increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CM 20 Corps of Eng
Project Name Cuchillo Negro
U.S.G.S. No. ______ Town ______
State NM County or Parish Sierra
Location ______
___¼___¼___¼___¼ Sec.___ T___ R___

Depth Datum: ______, which is ______ ft. (above, below) land surface.
Altitude: MP ______ ft. Land surface 4662 ft.
Determined by ______
Operator(s) Hudson-Dewees
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

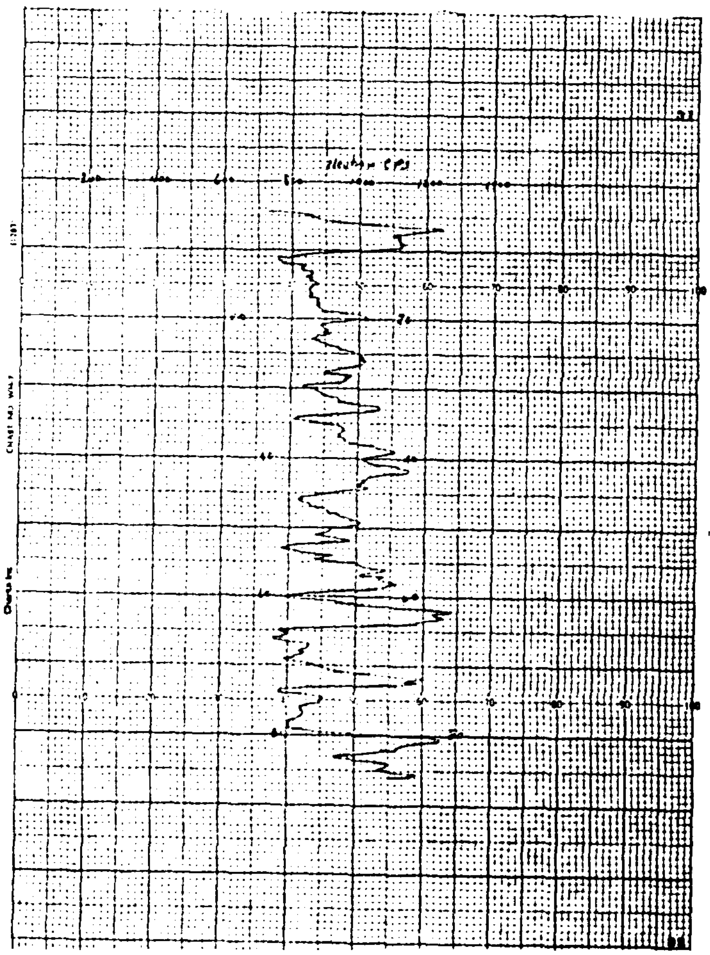
Water Level ___ ft. (above, below) ______ ______, which is ___ ft. (above, below) surface. Shut-in head after ___ (hrs., mins.)
Date 5/17/83
Depth drilled (feet): ______
Depth Measured (feet): 17
Interval logged: ___ ft. to ___ ft.

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Temp.: ______ B.H. Temp.: ______
Remarks: Porosity/moisture incr. left

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 curries AM-BE Spacers 17 in.
Hors. Scale 1K T.C 2 sec.
Sens. Scale 1.0 Base Scale 1.0



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or field no. [illegible]

Project name [illegible]

Geological Survey No. ____

State Utah County [illegible]

Location ____

¼ ¼ ¼ ¼ Sec. ___ T. ___ N/S R. ___ E/W

Depth Datum ____

which is ____ ft. (above, below) land surface.

Altitude: MP ____ ft. Land Surface 4662 ft

Determined by ____

Operator(s) [illegible]

Equipment (Vehicle No.) ____ Date ____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter. Type ____ Thickness ____ Characteristics.
____ ft, to ____
____ ft, to ____

Perforations, Screen: Type, size ____
____ ft, to ____
____ ft, to ____

Water Level ____ ft. (above, below) ____, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date 5/17/53

Total Depth 87 ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F
Date ____ Date ____

Water: Temperature ____ °F. at ____. Field Cond. ____
Ra(uu c/l ____ Beta-Gamma (uu c/l ____ U(10-3 gr/l ____

Logging Data

Run No. 1 of 1 runs. Probe Sensitivity (High

Descent: ___ ft./min. Gamma-Ray circuit scale ____
Potential circuit sr lo ____ Time constant ____

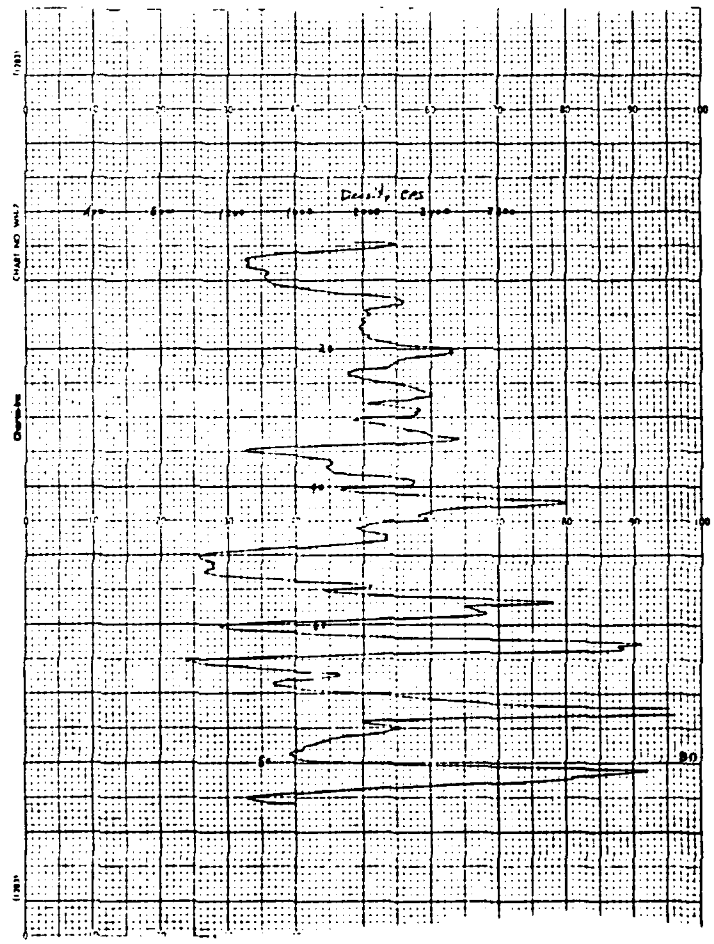
Logged out: ____ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale .5 Time constant 2

Statistical variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks [illegible]

Radiation intensity increase ____ Depth Scale ____ ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH 20 Corps of Eng

Project name Cuchillo Negro

U.S.G.S. No. ______ Town ______

State NM County or Parish Sierra

Location ______

____ ¼ ____ ¼ ____ ¼ ____ ¼ Sec. ____ T. ____ N/S R. ____ E/W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude: MP ___ ft. Land surface 4664 ft.

Determined by ______

Operator(s) Hudson - Dewees

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in., ______ ft. to ______ ft.
Diam. ______ in., ______ ft. to ______ ft.
Diam. ______ in., ______ ft. to ______ ft.

Bore: Diam. ______ in., ______ ft. to ______ ft.
Diam. ______ in., ______ ft. to ______ ft.
Diam. ______ in., ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______ ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date 5/17/81

Depth drilled (feet) ______

Depth measured (feet) 97

Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type: ______

Density, lbs./gal. ______

Viscosity, sec. ______

Resistivity, ohms: ______

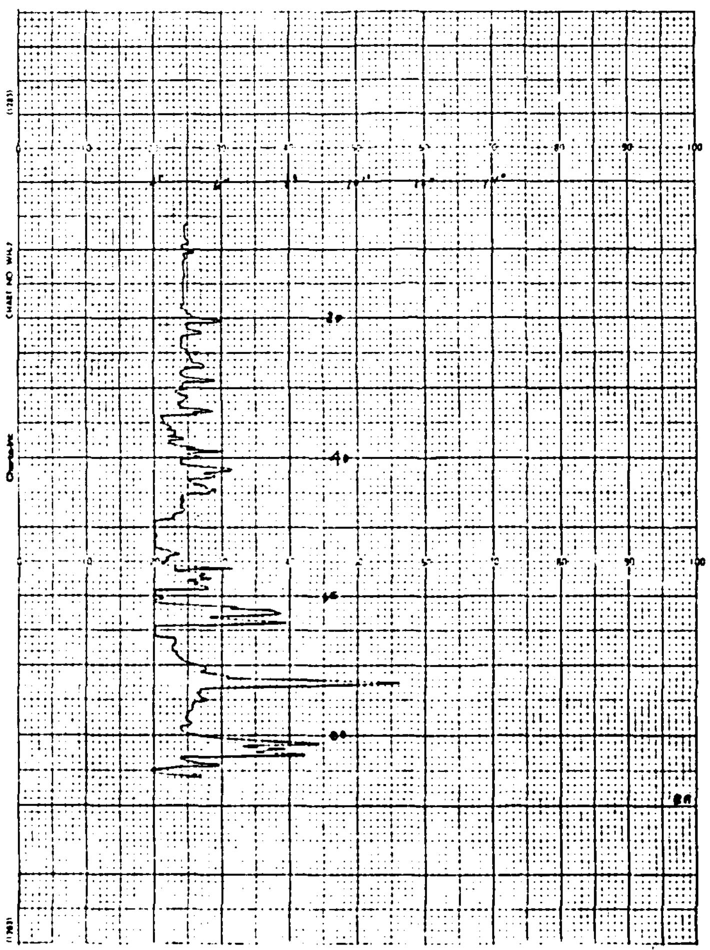
Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

Remarks: ______

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 20 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: Two in./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Geological Survey No. CH-21 Corp of Eng.
State NM County Sierra
Location ____
___¼___¼___¼___¼ Sec. ___T.___R.___
Depth Datum: ____
which is ____ ft. (above, below) land surface.
Altitude: MP ____ ft. Land surface 4220 ft
Determined by ____
Operator(s) Hudson - Powers
Equipment (Vehicle No.) ____ Date ____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ____ Thickness ____ Characteristics.
____ ft. to ____
____ ft. to ____

Perforations, Screen: Type, size ____
____ ft. to ____
____ ft. to ____

Water Level ____ ft. (above, below) ____, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date May 18, 1977
Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F.
Date ____ Date ____
Water: Temperature ____ °F. at ____. Field Cond. ____
Ra(uu c/L ____ Beta-Gamma (uu c/L ____ U(10-3 gr/l ____

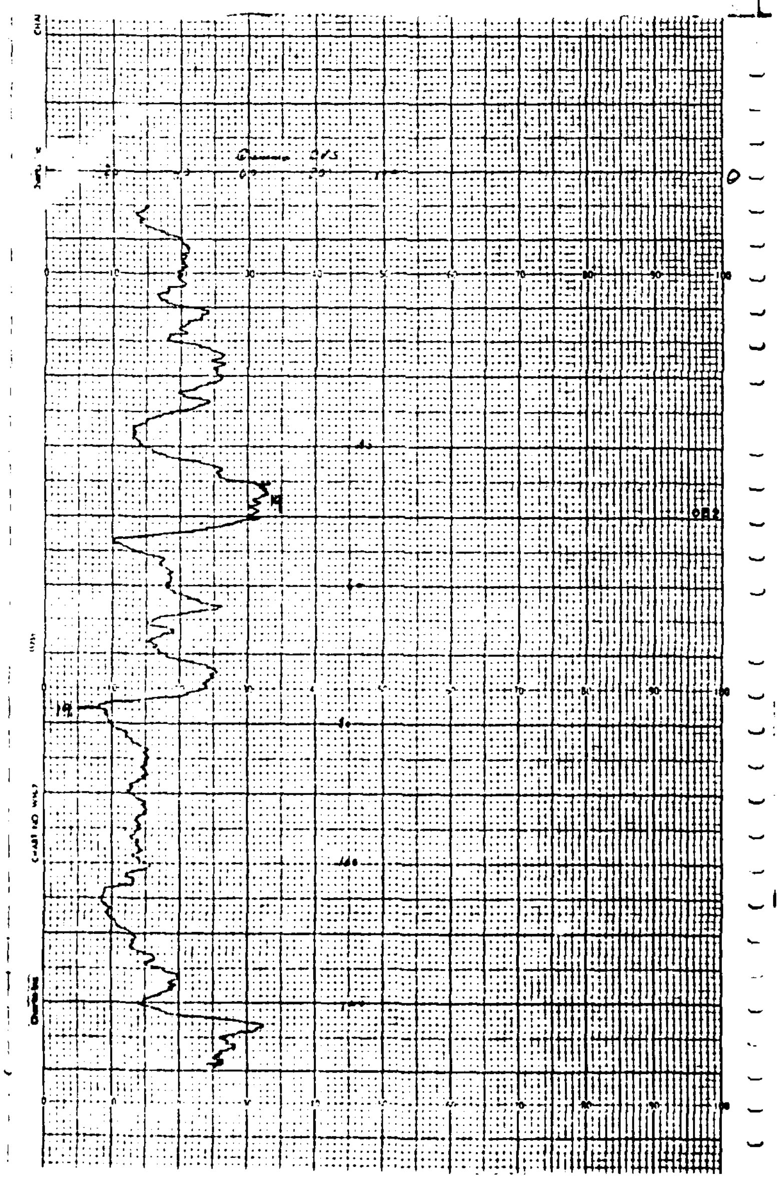
Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale ____ Time constant ____
Logged out: ____ ft./min. Gamma-Ray circuit scale 10 ɔ
Potential circuit scale 1.0 Time constant 4
Statistical Variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____.
Calibration in hole: (G-R Scale ____ Pot. circ..scale ____)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks ____

Radiation Intensity Increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CH-21 Corp of Eng

Project Name Cuchillo Negro

U.S.G.S. No. ____ Town ____

State NM County or Parish Sierra

Location ____

___¼___¼___¼___¼ Sec.___ T___ N/S R___ E/W

Depth Datum: ____, which is ____ ft. (above, below) land surface.

Altitude: KP ____ ft. Land surface 4780 ft.

Determined by ____

Operator(s) Hudson - Deaver

Equipment ____ Date ____

Equipment No.: ____ Vehicle No. ____

WELL LOGGING DATA

Casing: Diam. ____ in ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.

Bore: Diam. ____ in. ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.

Water Level ____ ft. (above, below) ____ ____, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)

Date May 13, 19[illegible]

Depth drilled (feet): ____

Depth Measured (feet): 128

Interval logged: ____ ft. to ____ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.

Vertical Scale 10 ft./in.

Source 3 curries AM-BE Spacers 17 in.

Hors. Scale 1:C T.C. 2 sec.

Sens. Scale 1 Base Scale 10

FLUID DATA

Type: ____

Density, lbs./gal. ____

Viscosity, sec. ____

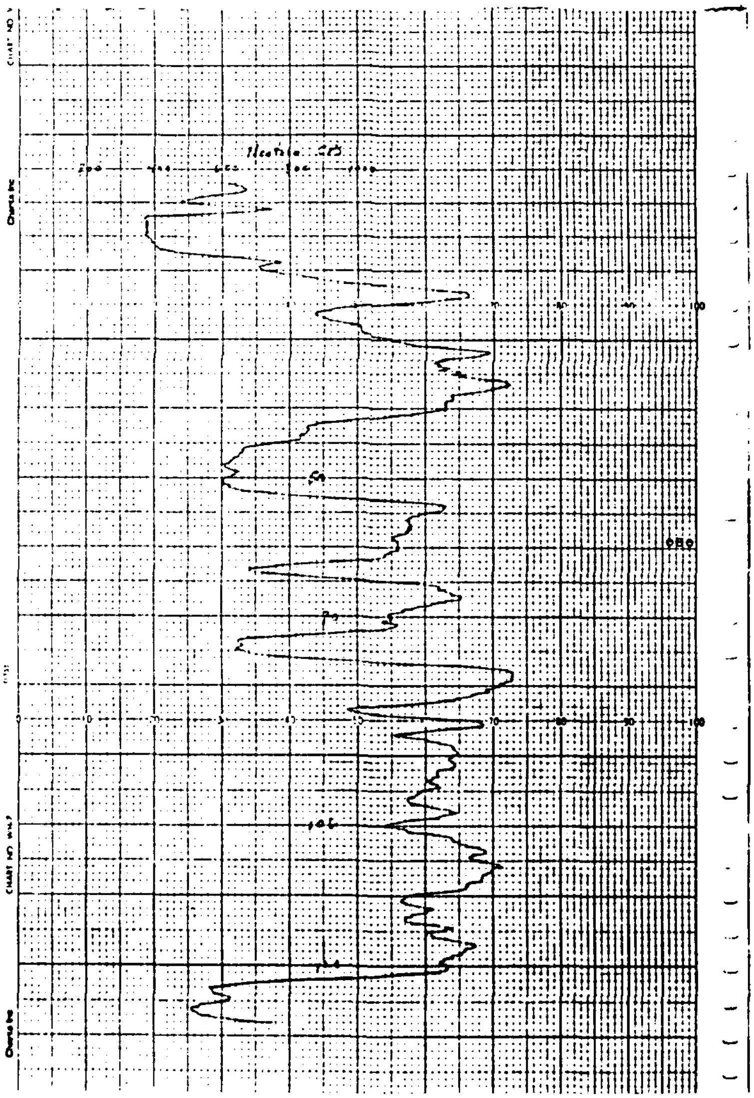
Resistivity, ohms: ____

Resistivity, B.H.T., ohms: ____ pH: ____

Circ. Temp.: ____ B.H. Temp.: ____

Remarks:

Porosity increase max. left



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or Field no. CH 11 [illegible]
Project name [illegible]
Geological Survey no. ________
State [illegible] County [illegible]
Location ________
___ ¼ ___ ¼ ___ ¼ ___ ¼ Sec. ___ T. ___ N/S R. ___ E/W
Depth Datum: ________,
which is ________ ft. (above, below) land surface.
Altitude: MP ________ ft. Land surface 4710 ft
Determined by ________
Operator(s) [illegible]
Equipment (Vehicle no.) ________ Date ________

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ________ Thickness ________ Characteristics,
________ ft, to ________ ________
________ ft, to ________ ________

Perforations, Screen: Type, size ________
________ ft, to ________
________ ft, to ________

Water Level ________ ft. (above, below) ________
________, which is ____ ft. (above, below) surface. Shut-in head after ________ (hrs., mins.)
Date [illegible]

Total Depth ________ ft. Interval Logged ________ ft. to ________ ft.

Fluid in hole: ________ Characteristics ________
Fluid level ________ ft. Fluid Temperature ________ °F.
Date ________ Date ________

Water: Temperature ________ °F. at ________. Field Cond. ________
Ra(uu c/L ________ Beta-Gamma (uu c/L ________ U(10-3 gr/l ________

Logging Data

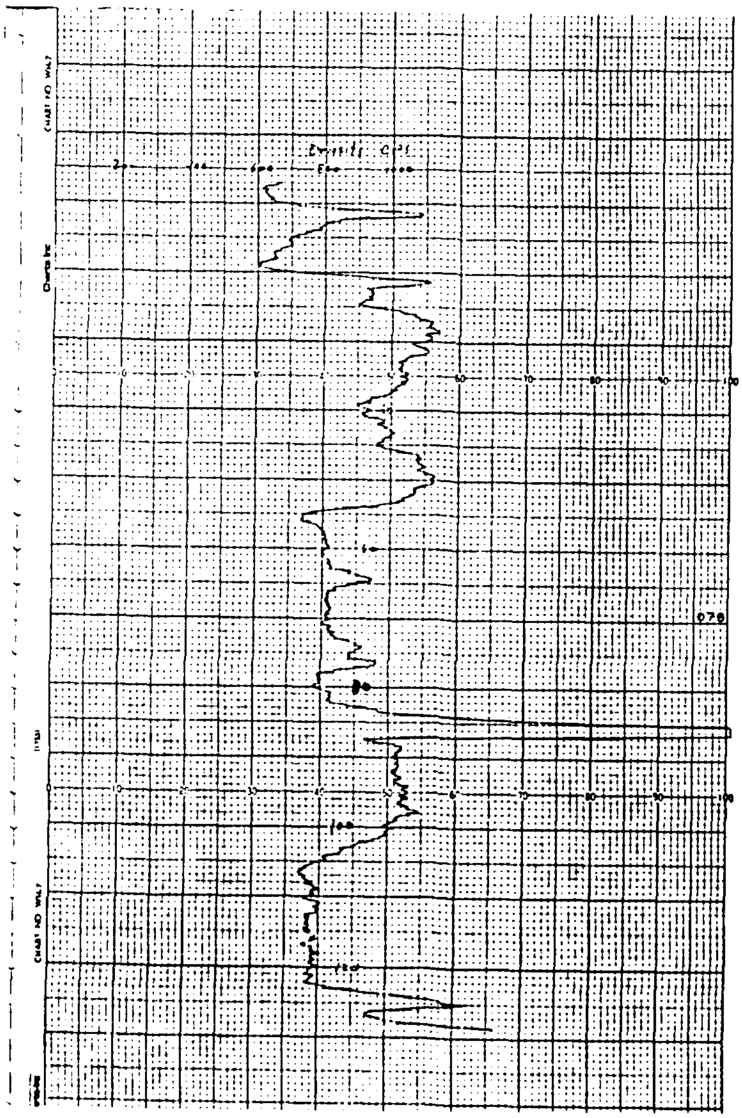
Run No. ____ or ____ runs. Probe Sensitivity (High
Descent: ____ ft./min. Gamma-Ray circuit scale ________
Potential circuit scale ________ Time constant ____
Logged out: ________ ft./min. Gamma-Ray circuit scale [illegible]
Potential circuit scale / b Time constant [illegible]

Statistical Variation ________ in. at ________ ft. Meter Reading ________ G-R Scale ________ Time Constant ________

Calibration in hole: (G-R Scale ________ Pot. circ. scale ____)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks [illegible]

Radiation Intensity Increase ——> Depth Scale: 10 ft./in.



60' [illegible]

U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

CALIPER LOG

Owner or field no. CH 21 Corp of Eng

Project name Cochille Mayo

U.S.G.S. No. ______ Town ______

State NM County or Parish Sicuca

Location ______

___¼___¼___¼___¼ Sec.___ T___ N/S R___ E/W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude. MP ___ ft. Land surface 4720 ft.

Determined by ______

Operator(s) Hudson - Dewees

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing. Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______ ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 12, 1988

Depth drilled (feet) ______

Depth measured (feet) 128

Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type: ______

Density, lbs./gal. ______

Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

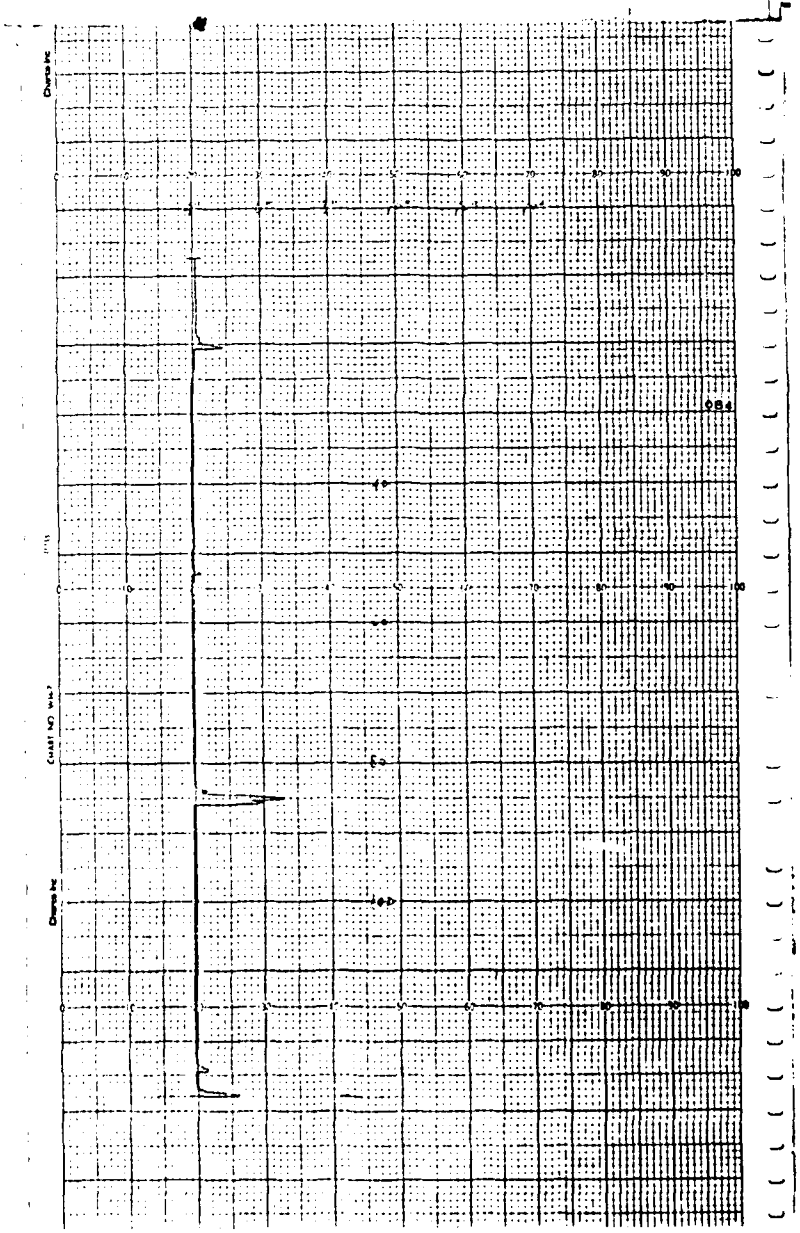
Remarks: ______

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.

Vertical scale: 10 ft./in.

Horizontal scale: Two in./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

GAMMA LOG

Geological Survey No. CH-22 Corp of Eng
State N.M County Sierra
Location Cuchillo Negro
___ ___ ___ ___ Sec. ___ T ___ R ___
Depth Datum ______
which is ______ ft. (above, below) land surface.
Altitude: MP ______ ft. Land surface 4742 ft
Determined by ______
Operator(s) Hudson-Dewees
Equipment (Vehicle No.) ______ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics,
______ ft. to ______ ______
______ ft. to ______ ______

Perforations, Screen: Type, size ______
______ ft. to ______
______ ft. to ______

Water Level ______ ft. (above, below) ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date May 18, 1981

Total Depth ______ ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole: ______ Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______

Water: Temperature ______ °F. at ______. Field Cond. ______
Ra (uu c/L ______ Beta-Gamma (uu c/L ______ U(10-3 gr/l ______

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ___
Logged out: ______ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 1.0 Time constant 3

Statistical Variation ______ in. at ______ ft. Meter Reading ______ G-R Scale ______ Time Constant ______.

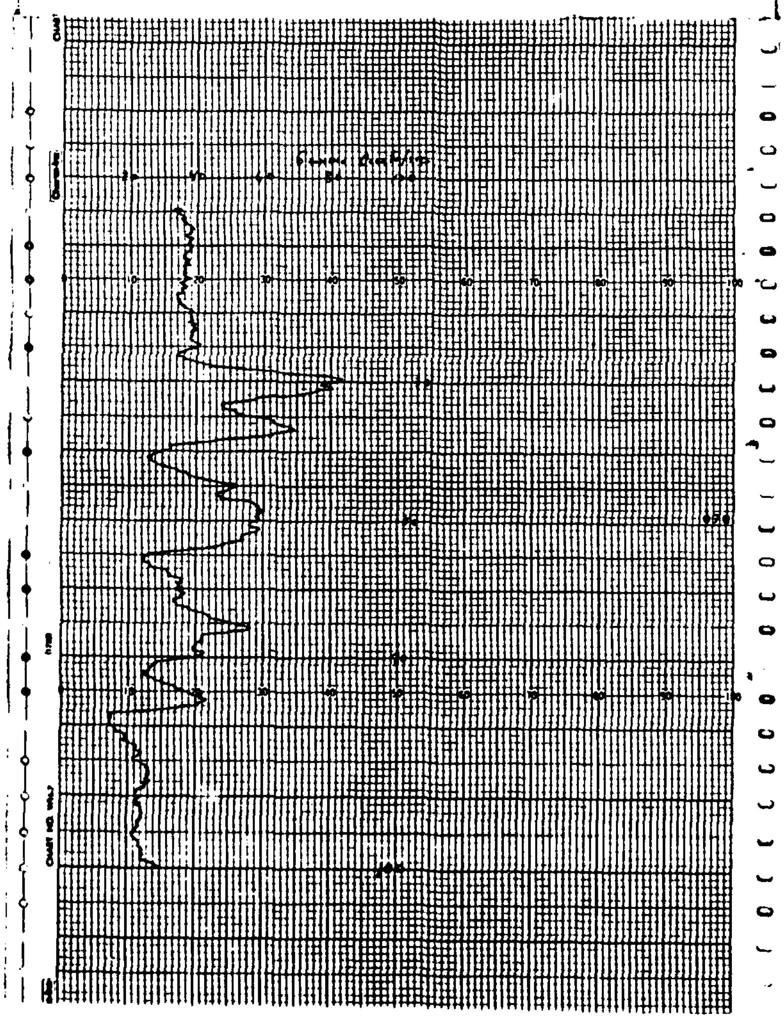
Calibration in hole: (G-R Scale ______ Pot. circ. scale ___)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks ______

Radiation Intensity Increase →

Depth Scale: 20 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

NEUTRON LOG

HOLE LOGGING DATA

Casing: Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.

Bore: Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.
Diam.____ in.____ ft. to ____ ft.

Water Level____ ft. (above,below) ____
____, which is____ ft. (above,below)
surface. Shut-in head after ____ (hrs.,mins.)
Date May 17, 1977

Depth drilled (feet): ____
Depth Measured (feet): 100
Interval Logged: ____ ft. to ____ ft.

OPERATION DATA

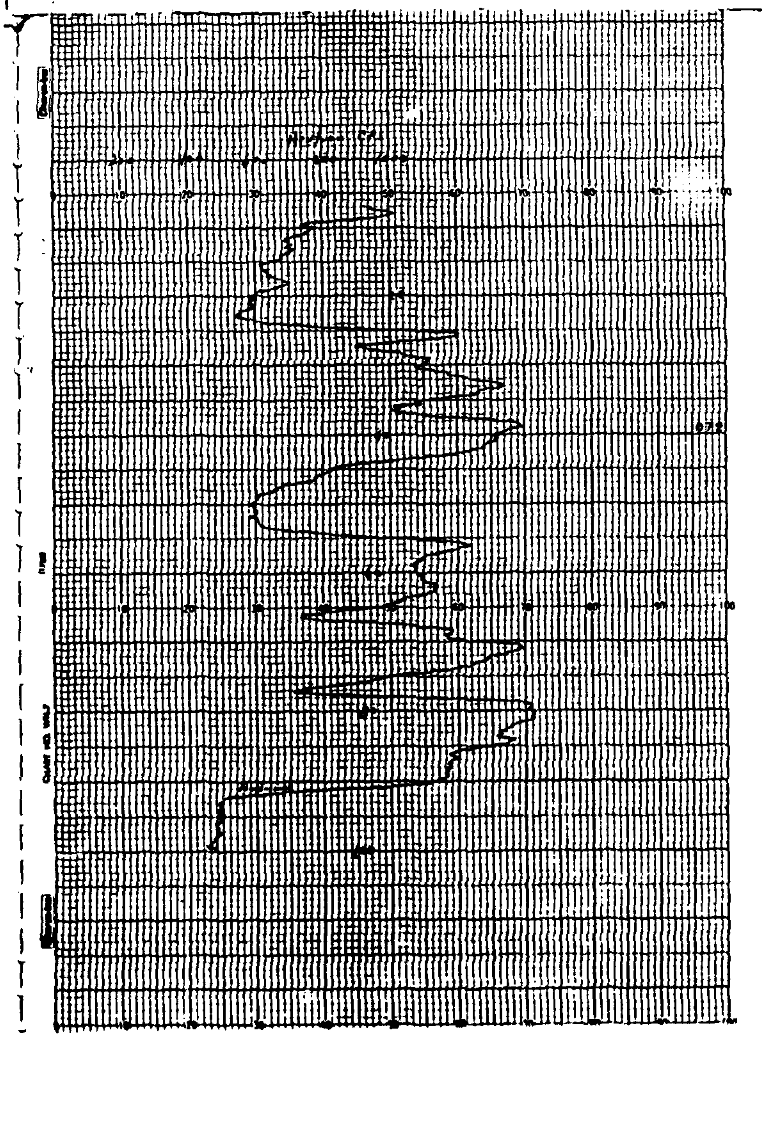
Run No. 1 of 1 runs. Logging Speed: 20 ft./min.
Vertical Scale 10 ft./in.
Source 3 curies AM-BE Spacers 17 in.
Hors. Scale 1K T.C. 2 sec.
Sens. Scale 1.0 Base Scale 10.0

Owner or Field No. CH 22 Corp of Eng.
Project Name Cochiti Nepo
U.S.G.S. No. ____ Town ____
State NM County or Parish Sierra
Location ____
____ ¼ ____ ¼ ____ ¼ ____ ¼ Sec.____ T.____ N/S R.____ E/W

Depth Datum: ____, which is ____ ft. (above, below) land surface.
Altitude: MP____ ft. Land surface 4746 ft.
Determined by ____
Operator(s) Hudson - Bowers
Equipment____ Date____
Equipment No.:____ Vehicle No.____

FLUID DATA

Type: ____
Density, lbs./gal. ____
Viscosity, sec. ____
Resistivity, ohms: ____
Resistivity, S.B.T., ohms: ____ pH: ____
Circ. Temp.: ____ B.H. Temp.: ____
Remarks: Density/moisture lower Left



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or Field no: CH 22 Corp of Eng

Project Name: Cochiti Dam

Geological Survey No. ______

State: N M County: Sandoval

Location ______

Depth Datum ______ which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land Surface 4741 ft

Determined by ______

Operator(s) Hodges - Dewees

Equipment (Vehicle No.) ______ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics ______
______ ft. to ______
______ ft. to ______

Perforations, Screen: Type, size ______
______ ft. to ______
______ ft. to ______

Water Level ______ ft. (above, below) ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 18 1981

Total Depth ______ ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole: ______ Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______

Water: Temperature ______ °F. at ______. Field Cond. ______
Gamma c/l ___ Beta-Gamma (as c/l ___ U(10-3 gr/l ______

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High

Constant: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ______

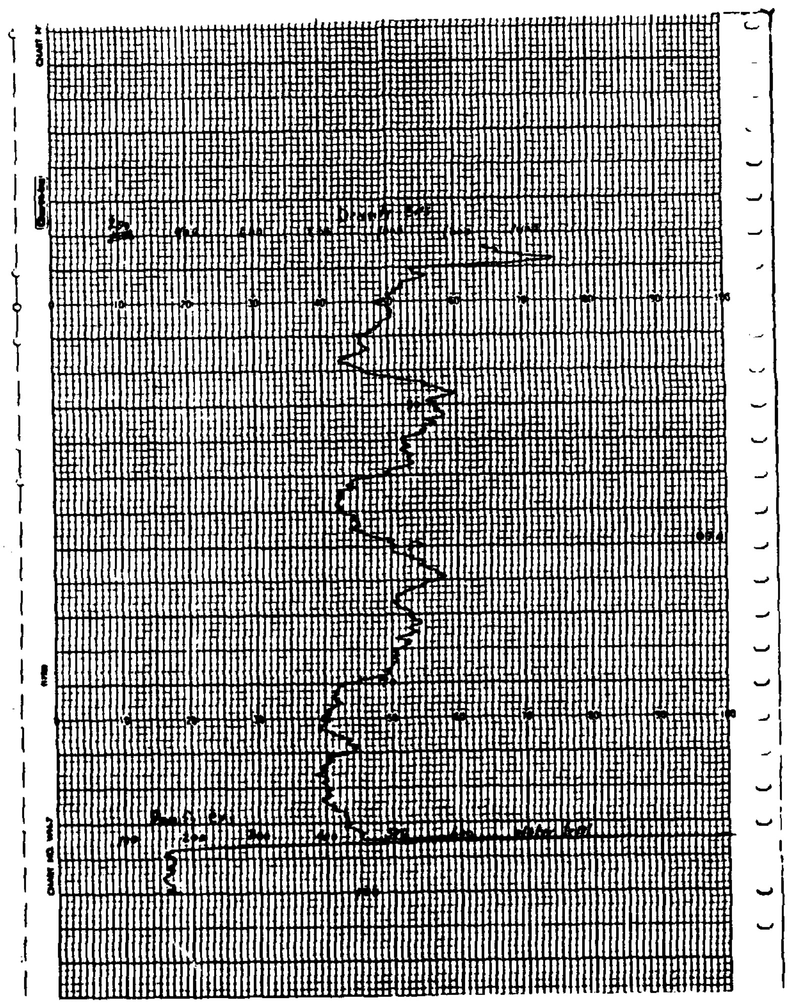
Logged out: ______ ft./min. Gamma-Ray circuit scale 100/10
Potential circuit scale 1.0 Time constant 2

Statistical Variation ______ in. at ______ ft. Meter Reading ______ G-R Scale ______ Time Constant ______

Calibration in hole: (G-R Scale ______ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks Bulk Density incr. left

Radiation intensity increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-22 Corp of Eng.
Project Name Cuchillo Negro
U.S.G.S. No. ______ Town ______
State NM County or Parish Sierra
Location ______
______ Sec. ___ T. ___ N/S R. ___ E/W
Depth Datum ______, which is ______ ft. (above, below) land surface.
Altitude: MP ___ ft. Land surface 4942 ft.
Determined by ______
Operator(s) Hudson - Dewkes
Equipment ______ Date ______
Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

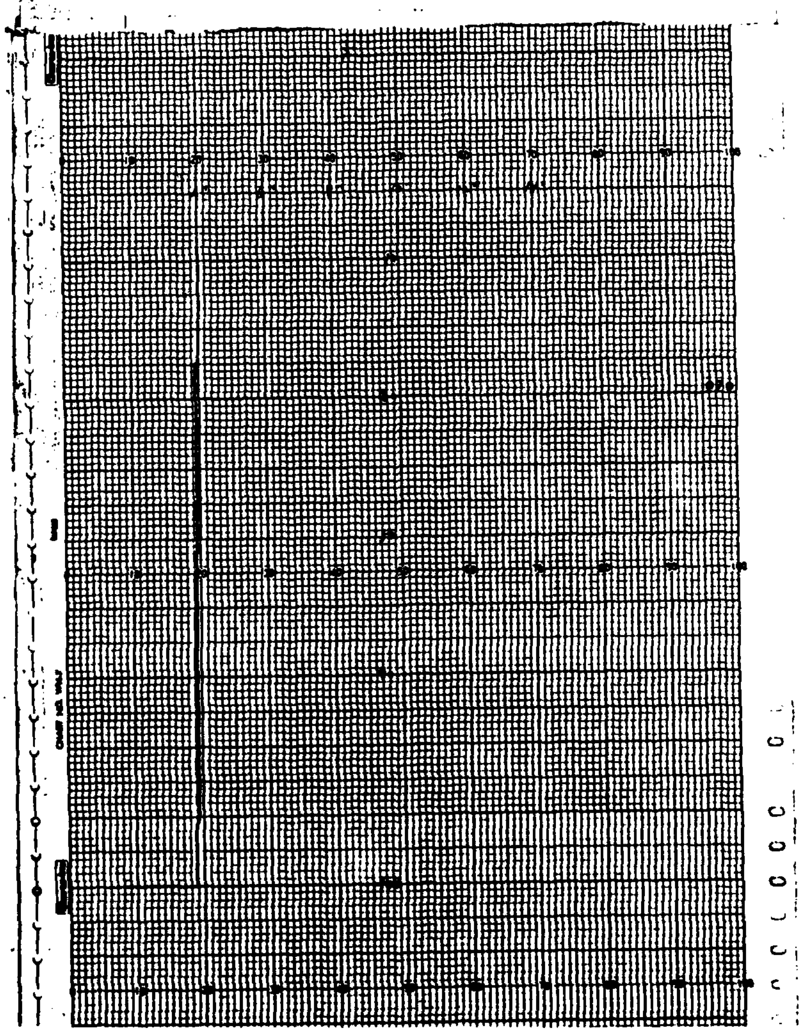
Water Level ______ ft. (above, below) ______
______, which is ___ ft. (above, below)
surface. Shut-in head after ______ (hrs., mins.)
Date May 18, 1988
Depth drilled (feet) ______
Depth measured (feet) 100
Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.
Vertical scale: 10 ft./in.
Horizontal scale: Two in./in.

FLUID DATA

Type: ______
Density, lbs./gal. ______
Viscosity, sec. ______
Resistivity, ohms: ______
Resistivity, B.H.T., ohms: ______ pH: ______
Circ. Time: ______ B.H. Temp.: ______
Remarks: ______



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Geological Survey No. CH-23 Cuy. el Ñwe

State NM County Sierra

Location Cuchillo Negro

___¼ ___¼ ___¼ ___¼ Sec. ___ T. ___ R. ___

Depth Datum: ________
which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface 4660 ft

Determined by ________

Operator(s) Hudson-Dewees

Equipment (Vehicle No.) ________ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics,
______ ft, to ______
______ ft, to ______

Perforations, Screen: Type, size ______
______ ft, to ______
______ ft, to ______

Water Level ______ ft. (above, below) ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)
Date May 17, 1977

Total Depth ______ ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole: Dry Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.
Date ______ Date ______

Water: Temperature ______ °F. at ______. Field Cond. ______
Ra (uu c/L ______ Beta-Gamma (uu c/L ______ U(10-3 gr/l ______

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High

Descent: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ______

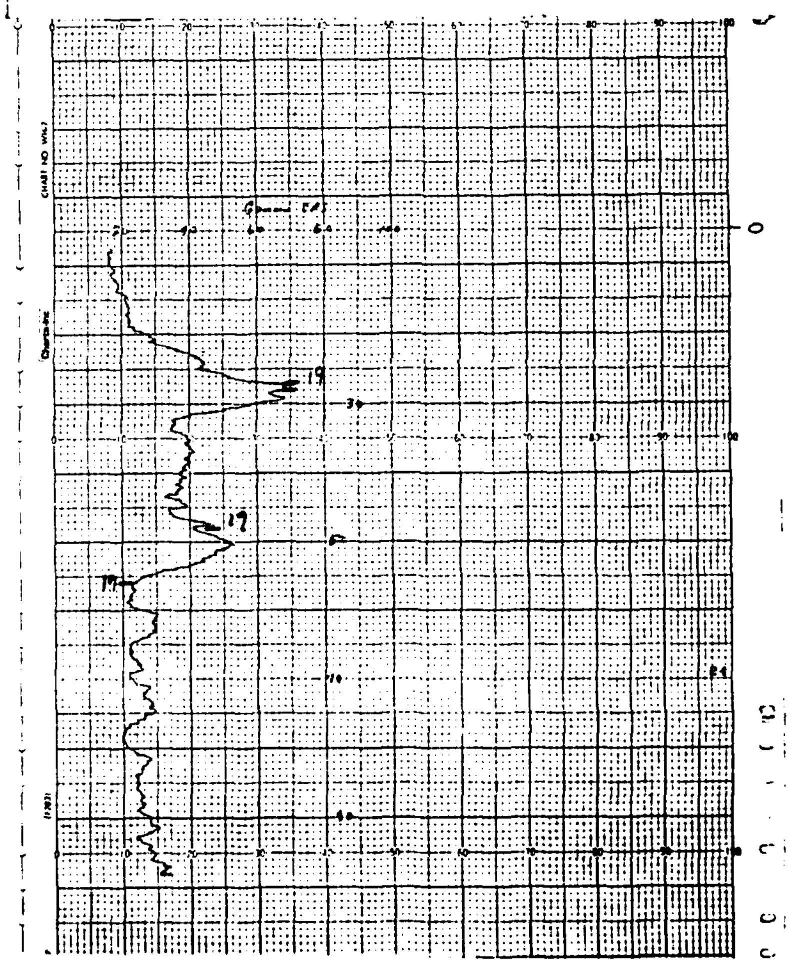
Logged out: ___ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 1.0 Time constant 2

Statistical Variation ___ in. at ___ ft. Meter Reading ___ G-R Scale ___ Time Constant ___

Calibration in hole: (G-R Scale ___ Pot. circ. scale ___)
Depth (ft.) Obs. Time (min.) Meter Reading

Remarks ______

Radiation Intensity Increase → Depth Scale: 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CH-23 Corp of Eng.

Project Name Cuchillo Negro

U.S.G.S. No. ______ Town ______

State NM County or Parish Sierra

Location ______

__¼__¼__¼__¼ Sec.__ T.__ N/S R.__ E/W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface 4660 ft.

Determined by ______

Operator(s) Hudson - Dewees

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______
______, which is ______ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date 5/17/88

Depth drilled (feet): ______

Depth Measured (feet): 98

Interval logged: ______ ft. to ______ ft.

OPERATION DATA

Run No. 1 of 1 runs. Logging Speed: 20 ft./min.

Vertical Scale ______ ft./in.

Source 3 curries AM-BE Spacers 17 in.

Hors. Scale 115 T.C. 2 sec.

Sens. Scale 1.0 Base Scale 1.0

FLUID DATA

Type: ______

Density, lbs./gal. ______

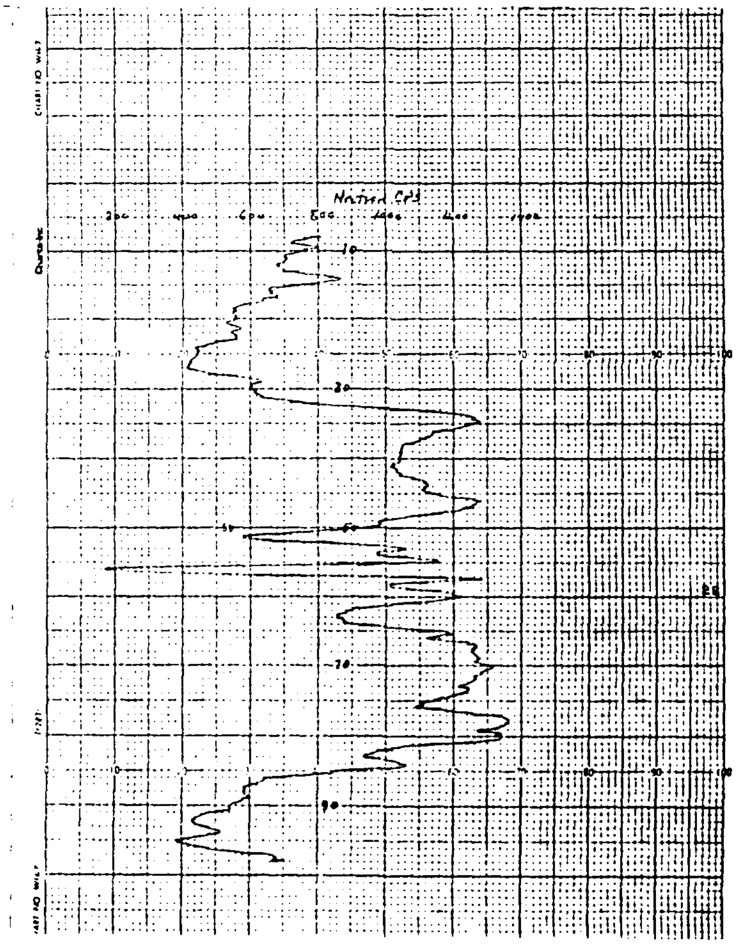
Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

Remarks: Porosity [illegible] left
Water coming into hole at 56 ft



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or Field no. [illegible]
Project name [illegible]
Geological Survey no. ____
State [illegible] County [illegible]
Location ____
____¼ ____¼ ____¼ ____¼ Sec. ____ T. ____ N/S R. ____ E/W
Depth Datum ____
which is ____ ft. (above, below) land surface.
Altitude. MP ____ ft. Land surface 4660 ft
Determined by ____
Operator(s) [illegible]
Equipment (Vehicle no.) ____ Date ____

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ____ Thickness ____ Characteristics,
____ ft, to ____ ____
____ ft, to ____ ____

Perforations, Screen: Type, size ____
____ ft, to ____
____ ft, to ____

Water Level ____ ft. (above, below) ____, which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date [illegible]

Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F.
Date ____ Date ____

Water: Temperature ____ °F. at ____. Field Cond. ____
Ra/uu c/L ____ Beta-Gamma (uu c/L ____ U(10-3 gr/l ____

Logging Data

Run No. ___ of 1___ runs. Probe Sensitivity (High
Descent: ___ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale ____ Time constant ____
Logged out. 20 ft./min. Gamma-Ray circuit scale [illegible]
Potential circuit scale 10 Time constant [illegible]

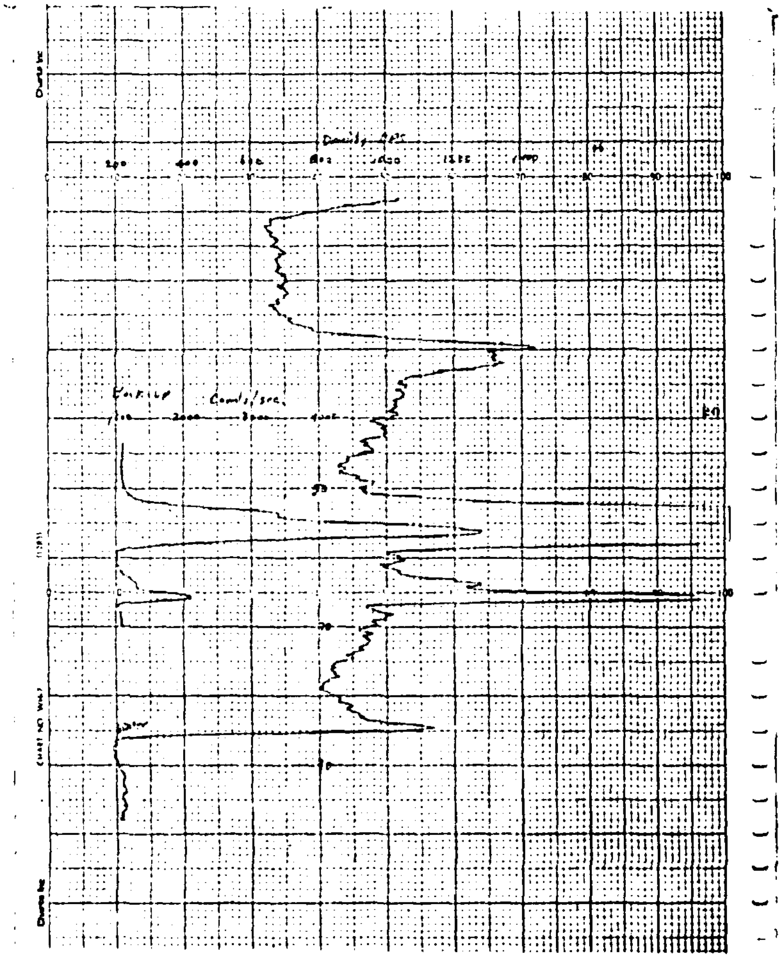
Statistical Variation ____ in. at ____ ft. Meter
Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-G Scale ____ Pot. circ. scale ____)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks [illegible]

Radiation Intensity Increase ____ > ____ Depth Scale ____ ft./in.



U. S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field no. *CH-23 Corp of Eng.*
Project Name *Cochillo Negro*
U.S.G.S. No. ________ Town ________
State *N M* ________ County or Parish *Sierra*
Location ________
___ ¼ ___ ¼ ___ ¼ ___ ¼ Sec. ___ T ___ N/S R ___ E/W
Depth Datum: ________, which is ________ ft. (above, below) land surface.
Altitude: MP ___ ft. Land surface *4660* ft.
Determined by ________
Operator(s) *Hudson - Dewees*
Equipment ________ Date ________
Equipment No.: ________ Vehicle No. ________

HOLE LOGGING DATA

Casing: Diam. ________ in. ________ ft. to ________ ft.
Diam. ________ in. ________ ft. to ________ ft.
Diam. ________ in. ________ ft. to ________ ft.

Bore: Diam. ________ in. ________ ft. to ________ ft.
Diam. ________ in. ________ ft. to ________ ft.
Diam. ________ in. ________ ft. to ________ ft.

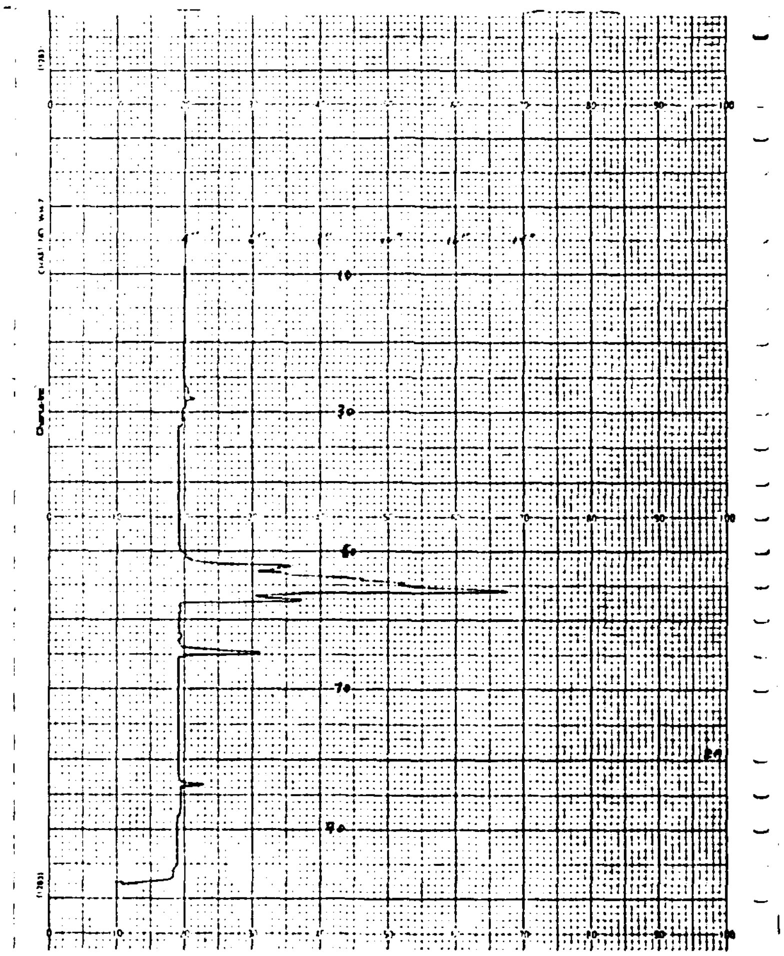
Water Level ________ ft. (above, below) ________
________, which is ___ ft. (above, below) surface. Shut-in head after ________ (hrs., mins.)
Date *May 17, 1978*
Depth drilled (feet) ________
Depth measured (feet) *95*
Interval logged: ________ ft. to ________ ft.

FLUID DATA

Type: ________
Density, lbs./gal. ________
Viscosity, sec. ________
Resistivity, ohms: ________
Resistivity, B.H.T., ohms: ________ pH: ________
Circ. Temp.: ________ B.H. Temp.: ________
Remarks: ________

OPERATION DATA

Run No. *1* of *1* runs. Logging speed: *20* ft./min.
Vertical scale: *10* ft./in.
Horizontal scale: *Two* in./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA LOG

Project name Cuchillo Negro

Geological Survey no. ______

State NM County Sierra

Location ______

____ ____ ____ ____ Sec. ____ T ____ R ____

Depth Datum. ______

which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface ______ ft

Determined by ______

Operator(s) Hudson - Davies

Equipment (Vehicle No.) ______ Date ______

Casing Data

Casing: Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.
Diam. ___ in. ___ ft. to ___ ft. Thickness ___ in.

Bore: Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.
Diam. ___ in. ___ ft. to ___ ft.

Filter: Type ______ Thickness ______ Characteristics,
______ ft, to ______ ______
______ ft, to ______ ______

Perforations, Screen: Type, size ______
______ ft, to ______
______ ft, to ______

Water Level ______ ft. (above, below) ______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 19, 1981

Total Depth 42 ft. Interval Logged ______ ft. to ______ ft.

Fluid in hole. ______ Characteristics ______
Fluid level ______ ft. Fluid Temperature ______ °F.

Date ______ Date ______

Water: Temperature ______ °F. at ______. Field Cond. ______

Ra(uu c/L ______ Beta-Gamma (uu c/L ______ U(10-3 gr/l ______

Logging Data

Run No. ___ of ___ runs. Probe Sensitivity (High

Descent: ___ ft./min. Gamma-Ray circuit scale ______
Potential circuit scale ______ Time constant ___

Logged out: ______ ft./min. Gamma-Ray circuit scale 100
Potential circuit scale 10 Time constant 1

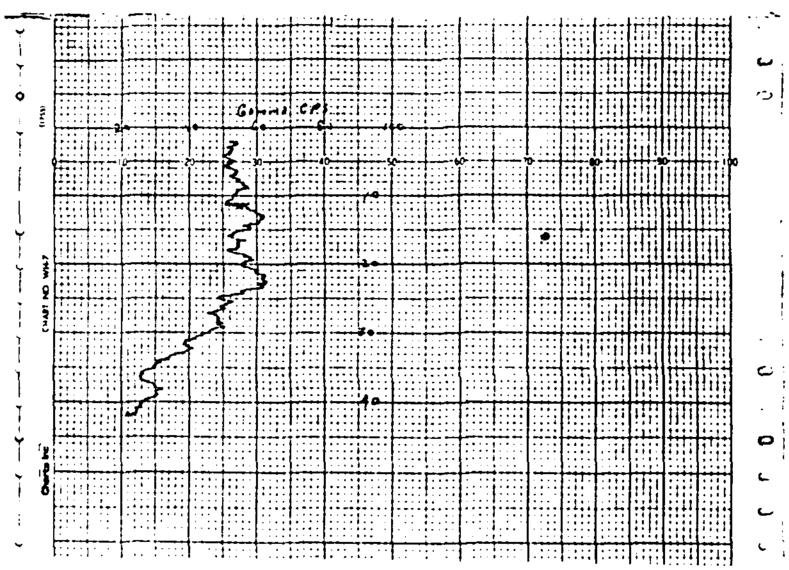
Statistical Variation ______ in. at ______ ft. Meter Reading ______ G-R Scale ______ Time Constant ______

Calibration in hole: (G-R Scale ______ Pot. circ. scale ___)

Depth (ft.) Obs. Time (min.) Meter Reading

Remarks Only log made in this hole

Radiation intensity increase ——→ Depth Scale. 10 ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

NEUTRON LOG

Owner or Field No. CH-25 Corps of Eng

Project Name Cuchillo Negro

U.S.G.S. No. ______ Town ______

State N Mex County or Parish Sierra

Location ______

___¼___¼___¼___¼ Sec.___ T___N S___E W

Depth Datum: ______, which is ______ ft. (above, below) land surface.

Altitude: MP ______ ft. Land surface 4610 ft.

Determined by ______

Operator(s) Hudson - Dewees

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.
Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______ ______, which is ______ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 17, 1988

Depth drilled (feet): ______

Depth Measured (feet): 79

Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type: ______

Density, lbs./gal. ______

Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ pH: ______

Circ. Temp.: ______ B.H. Temp.: ______

Remarks: Porosity/moisture incr. left

OPERATION DATA

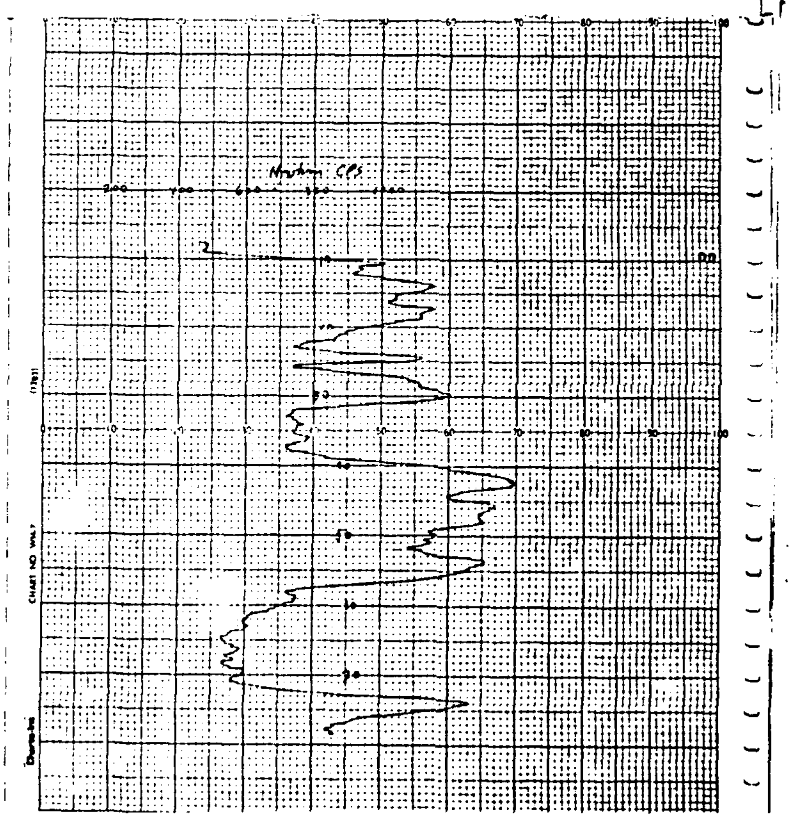
Run No. 1 of 1 runs. Logging Speed: 20 ft./min.

Vertical Scale 10 ft./in.

Source 3 curries AM-BE Spacers 17 in.

Hors. Scale 1K T.C. 2 sec.

Sens. Scale 1.0 Base Scale 10



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

GAMMA-GAMMA LOG

Owner or Field no: CH-15 Corp of Eng

Project Name Cuchilla Negra

Geological Survey No. ____

State Fla County Sierra

Location ____

____ ¼ ____ ¼ ____ ¼ ____ ¼ Sec. ____ T ____ N/S R ____ E/W

Depth Datum: ____

which is ____ ft. (above, below) land surface.

Altitude MP ____ ft. Land surface 4/11D ft

Determined by ____

Operator(s) Hudson : Dewey

Equipment (vehicle No.) ____ Date ____

Casing Data

Casing: Diam. ____ in. ____ ft. to ____ ft. Thickness ____ in.
Diam. ____ in. ____ ft. to ____ ft. Thickness ____ in.
Diam. ____ in. ____ ft. to ____ ft. Thickness ____ in.

Bore: Diam. ____ in. ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.
Diam. ____ in. ____ ft. to ____ ft.

Filter: Type ____ Thickness ____ Characteristics,
____ ft, to ____ ____
____ ft, to ____ ____

Perforations, Screen: Type, size ____
____ ft, to ____
____ ft, to ____

Water Level ____ ft. (above, below) ____ , which is ____ ft. (above, below) surface. Shut-in head after ____ (hrs., mins.)
Date Aug 17, 1981

Total Depth ____ ft. Interval Logged ____ ft. to ____ ft.

Fluid in hole: ____ Characteristics ____
Fluid level ____ ft. Fluid Temperature ____ °F
Date ____ Date ____

Water. Temperature ____ °F. at ____ . Field Cond. ____
Ra(uu c/L ____ Beta-Gamma (uu c/L ____ U(10-3 gr/l ____

Logging Data

Run No. ____ of ____ runs. Probe Sensitivity (High

Descent: ____ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale ____ Time constant ____

Logged out: ____ ft./min. Gamma-Ray circuit scale ____
Potential circuit scale 10 Time constant 2

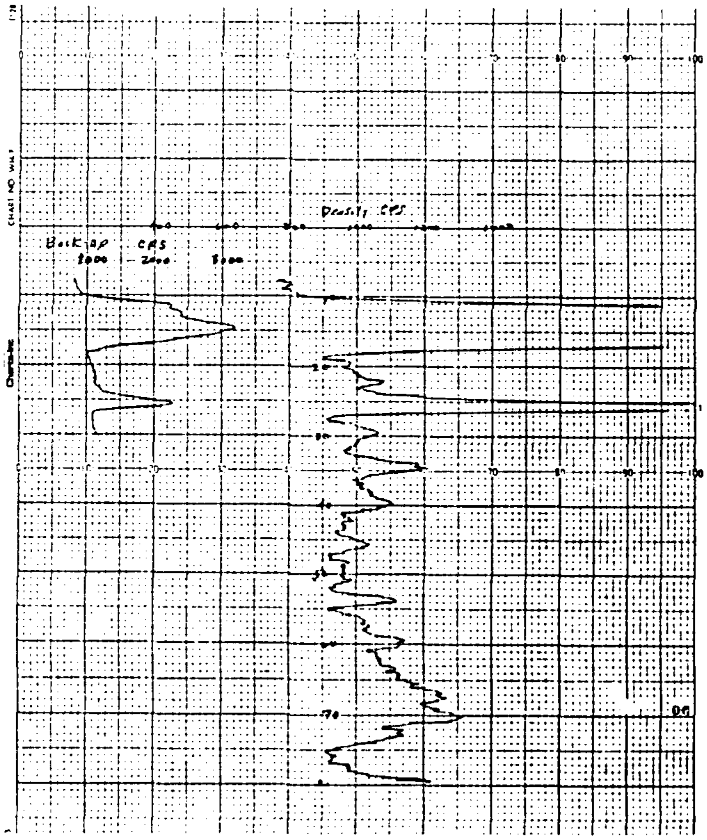
Statistical Variation ____ in. at ____ ft. Meter Reading ____ G-R Scale ____ Time Constant ____

Calibration in hole: (G-R Scale ____ Pot. circ. scale ____)

Depth (ft.)	Obs. Time (min.)	Meter Reading

Remarks ____

Radiation Intensity Increase ____ > ____ Depth Scale ____ ft./in.



U. S. GEOLOGICAL SURVEY

WATER RESOURCES DIVISION

CALIPER LOG

Owner or Field No. CH-25 Corps of Eng

Project Name Cuchilla Negra

U.S.G.S. No. ______ Town ______

State N.M. County or Parish Sierra

Location ______

___¼___¼___¼___¼ Sec.___T___N/S R___E/W

Depth Datum ______, which is ______ ft. (above, below) land surface.

Altitude: MP ___ ft. Land surface 4650 ft.

Determined by ______

Operator(s) Hudson - Dewees

Equipment ______ Date ______

Equipment No.: ______ Vehicle No. ______

HOLE LOGGING DATA

Casing: Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Bore: Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Diam. ______ in. ______ ft. to ______ ft.

Water Level ______ ft. (above, below) ______

______, which is ___ ft. (above, below) surface. Shut-in head after ______ (hrs., mins.)

Date May 12, 1983

Depth drilled (feet) ______

Depth measured (feet) 77

Interval logged: ______ ft. to ______ ft.

FLUID DATA

Type ______

Density, lbs./gal. ______

Viscosity, sec. ______

Resistivity, ohms: ______

Resistivity, B.H.T., ohms: ______ BM: ______

Circ. Temp.: ______ B.H. Temp.: ______

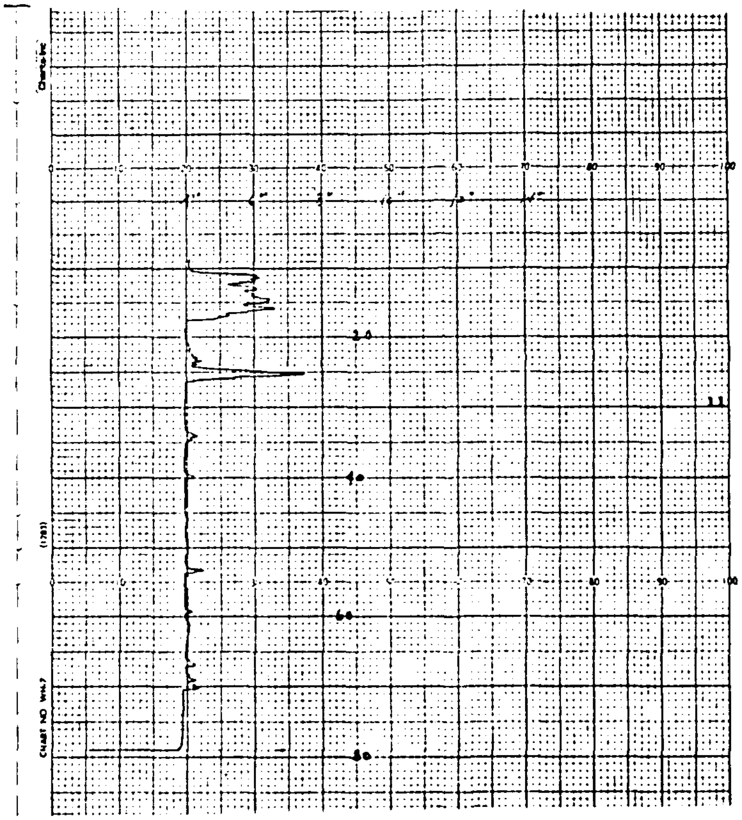
Remarks ______

OPERATION DATA

Run No. 1 of 1 runs. Logging speed: 15 ft./min.

Vertical scale: 10 ft./in.

Horizontal scale: Two in./in.



Aggregate Investigation Report

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SWDED-GL REPORT 14735 (10 pages)

PROJECT: CUCHILLO NEGRO DAM
Feature: AGGREGATE INVESTIGATION

Contract No.

TEST REQUEST NO.: E86880058
Dated: 28 June 88
Received: 05 July 88

From: Chief
Engineering Division
Albuquerque District

MATERIAL:
No. and type of samples: 1 Natural gravel and sand, 1 chunk stone
Source or other identification: Cuchillo Negro Dam

Date received: 17 June 88

REMARKS:

SEE ATTACHED PAGES.

Report sent to: Albuquerque District

Copy furnished:

Date: 24 Aug 88

Name and title:
WILLIAM R. TANNER
Director
SWD Laboratory

Signature
Wm R Tanner

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

1. REFERENCE: Reference is made to Albuquerque District test request E86880058, dated 28 June 88, requesting testing of concrete aggregate and riprap.

2. SAMPLES: The following samples were received 17 June 88:

SWD NO.	MATERIAL	SOURCE	AMOUNT
C-1846	NATURAL SAND AND GRAVEL	CUCHILLO NEGRO	66 BAGS
C-1847	CHUNK STONE	CUCHILLO NEGRO	1200 LB

3. PETROGRAPHIC REPORT:

A. C-1846. The natural sand and gravel consisted of well rounded particles of the following:

ROCK TYPE	PERCENT
ACID VOLCANIC	43.4
BASIC VOLCANIC	22.2
INTERMEDIATE VOLCANIC	17.0
QUARTZ	5.0
FELDSPAR	4.7
SANDSTONE	3.6
CHERT	3.3
LIMESTONE	0.8

The ACID VOLCANIC rocks were well rounded, fine-grained, slightly fractured, slightly weathered and ranged from reddish orange to purple in color. The fractures were hairline, tight and were well healed with quartz. The acid volcanic rocks appeared to be rhyolites in composition and about 30% were porphyritic. No volcanic glass was noted.

The BASIC VOLCANIC rocks were well rounded, fine-grained, slightly fractured, slightly weathered and ranged in color from medium to dark gray. The fractures were hairline, tight and were well healed with quartz. The basic volcanics appeared to be basalts in composition and about 20% were porphyritic.

The INTERMEDIATE VOLCANIC rocks were well rounded, fine-grained, slightly fractured, slightly weathered and ranged in color from yellowish green to light gray. The fractures were hairline, tight and well-healed with quartz. The intermediate volcanics appeared to be

andesites in composition. No volcanic glass was noted.

The QUARTZ was clear to white, hard, dense, durable and slightly weathered. The particles were subangular to subrounded. Slight iron-staining was noted on a few of the quartz grains.

The FELDSPAR was pink to white, moderately hard, dense, durable, and subrounded.

The SANDSTONE was greenish gray, fine-grained, slightly weathered and cemented with silica. The particles were rounded to subrounded in shape.

The CHERT was varicolored, hard, dense, durable, and was slightly fractured. The particles were subrounded to subangular in shape. No CHALCEDONY was noted.

The LIMESTONE was medium to dark gray, very fine-grained, dense, durable and moderately hard. Particle shape was rounded.

B. C-1847. The chunk stone sample consisted of medium to dark gray, fine-grained, slightly fractured, slightly weathered, moderately hard, dense, durable LIMESTONE. About 80% of the sample (C-1847-A) contained gray and light brown mottling. Twenty percent (C-1847-B) of the sample was thin-bedded. The fractures were hairline, tight and filled with calcite. Weathering was noted as a slight discoloration along the outer surfaces of the chunks and along fractures. Chunk size ranged from 6" x 8" x 10" to 12" x 14" x 22.

4. RESULTS OF FREEZE-THAW TESTING

A. C-1847-A and C-1846-B. After 20 cycles of freeze-thaw testing the slabs remained intact with only very minor slaking of sand-size particles (SEE PLATES 1 & 2).

5. RESULTS OF ALKALI-AGGREGATE REACTION, CHEMICAL TEST:

Results of the Chemical test for reactivity of aggregate with sodium hydroxide are listed in the following table:

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

Sample	Point	Sc	Rc
C-1846 Fines	A	90	249
	B	78	262
	C	89	255
C-1846 Corase	A	95	218
	B	62	214
	C	82	245

The tests show that both samples are innocuous, containing no reactive minerals. (SEE PLATE 3).

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

TABLE 1
OVERALL GRADATION

SWD SAMPLE NO.		C-1846
GRADATION, % PASSING		
	3"	100.0
	2 1/2"	99.3
	2"	97.8
	1-1/2"	95.5
	1"	89.6
	3/4"	84.2
	1/2"	75.1
	3/8"	67.6
	#4	51.1
	#8	38.5
	#16	27.9
	#30	18.6
	#50	9.1
	#100	4.7
	#200	2.9

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

TABLE 2
RESULTS OF TESTS OF PLUS #4 MATERIAL

SWD SAMPLE NO.		C-1846
GRADATION, % PASSING		
	3"	100.0
	2 1/2"	98.6
	2"	95.8
	1-1/2"	90.9
	1"	78.8
	3/4"	67.8
	1/2"	49.1
	3/8"	33.7
	#4	0.0
SPECIFIC GRAVITY (BULK SSD)		2.52
ABSORPTION, %		3.5
FLAT OR ELONGATED PARTICLES, %		3.2
LA ABRASION, "B" GRADING, 500 CYCLES, % LOSS		18.9
SOUNDNESS, MAGNESIUM SULFATE, 5 CYCLES, % LOSS		
	PLUS 1"	(3.0)
	1" - 3/4"	3.0
	3/4" - 3/8"	10.6
	3/8" - #4	25.3
WEIGHTED AVERAGE		13.1

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

TABLE 3
RESULTS OF TESTS OF MINUS #4 MATERIAL

SAMPLE NUMBER		C-1846
GRADATION, % PASSING		
	#4	100.0
	#8	75.3
	#16	54.7
	#30	36.4
	#50	17.8
	#100	9.2
	#200	5.7
SPECIFIC GRAVITY (BULK SSD)		2.49
ABSORPTION, %		4.3
ORGANIC IMPURITIES		SATISFACTORY
SOUNDNESS, MAGNESIUM SULFATE, 5 CYCLES, % LOSS		
	#4 - #8	39.3
	#8 - #16	22.0
	#16 - #30	14.7
	#30 - #50	11.0
	MINUS #50	(0.0)
WEIGHTED AVERAGE		19.0

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

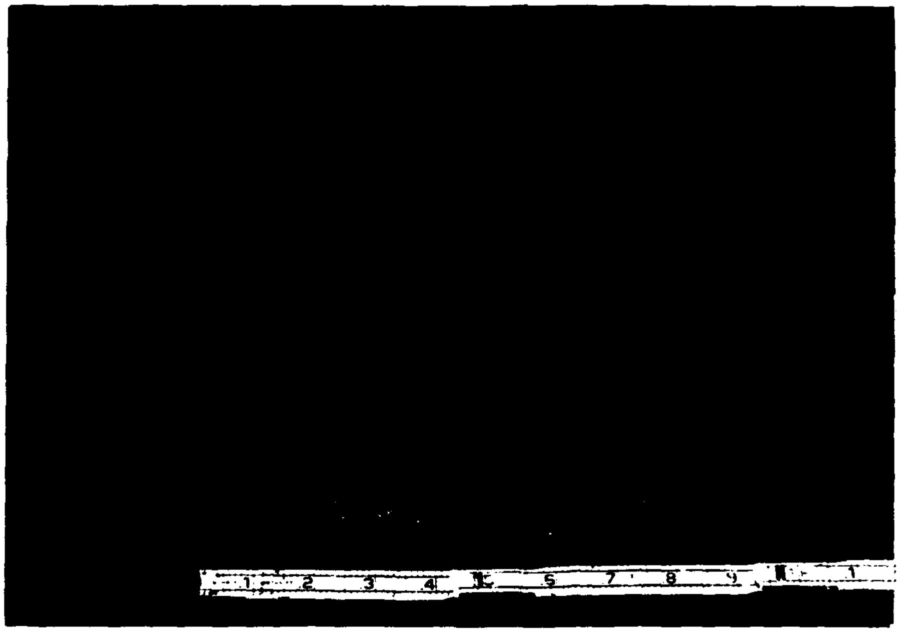
TABLE 4
RESULTS OF TESTS OF RIPRAP

SWD SAMPLE NO.	C-1846	C-1846-A	C-1846-B
SPECIFIC GRAVITY (BULK SSD)	2.70		
ABSORPTION, %	0.4		
LA ABRASION, "1" GRADING, 1000 REVOLUTIONS, % LOSS	35.5		
SOUNDNESS, MAGNESIUM SULFATE, % LOSS 2-1/2" - 1-1/2"	1.4		
SOUNDNESS, FREEZING AND THAWING			
NUMBER OF CYCLES		20	20
NUMBER OF FRAGMENTS*		1	1
% REMAINING*		97.4	95.4

*INCLUDES FRAGMENTS REMAINING AT END OF TEST WEIGHING MORE THAN 25% OF THE INITIAL DRY WEIGHT.

**SEE SAMPLE C-1530-1 RESULTS

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

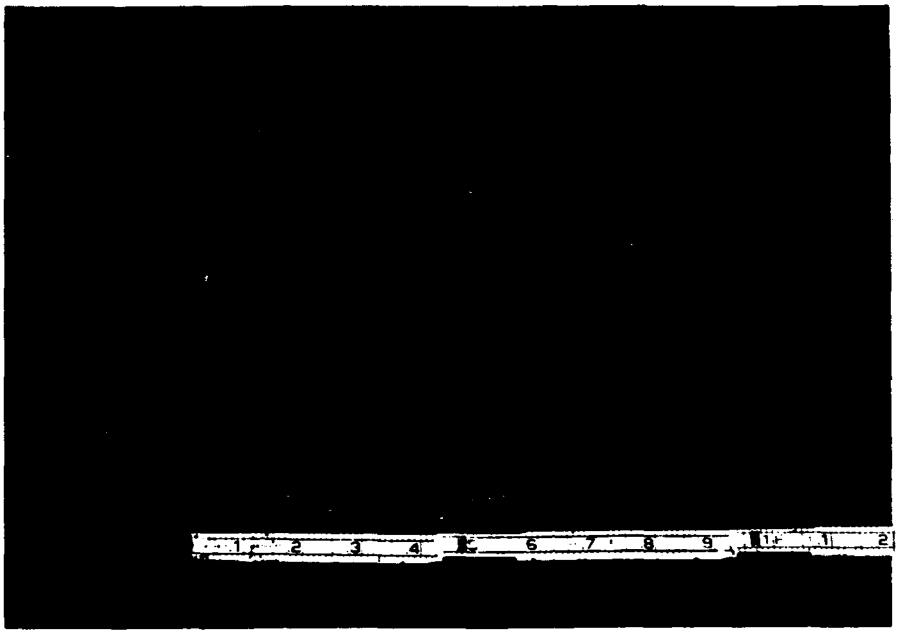


Sample C-1847-A before freezing and thawing.

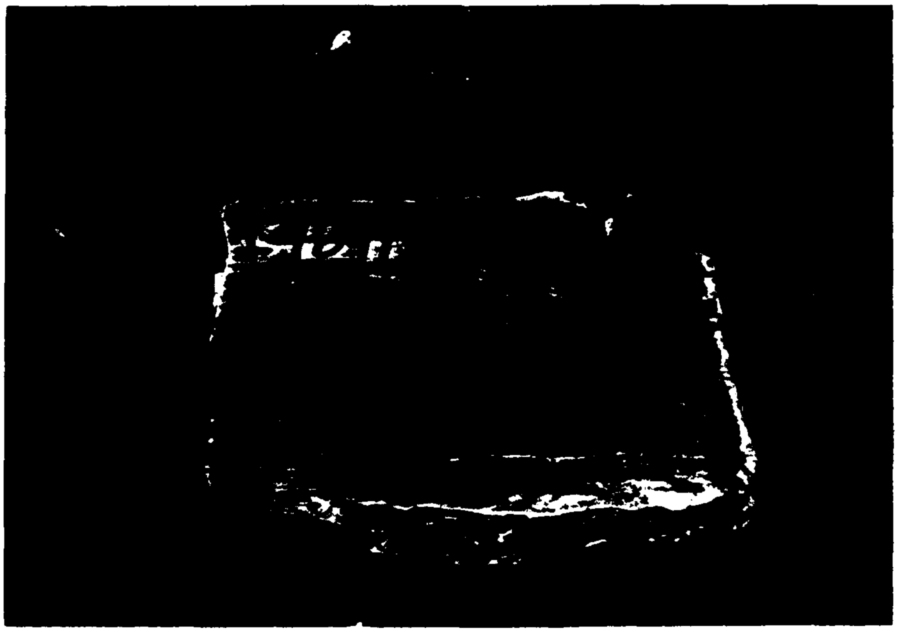
Sample C-1847-A after 20 cycles of freezing and thawing.

PLATE 1

ALBUQUERQUE DISTRICT
CUCHILLO NEGRO DAM
AGGREGATE ANALYSIS
SWDED-GL REPORT NO. 14735

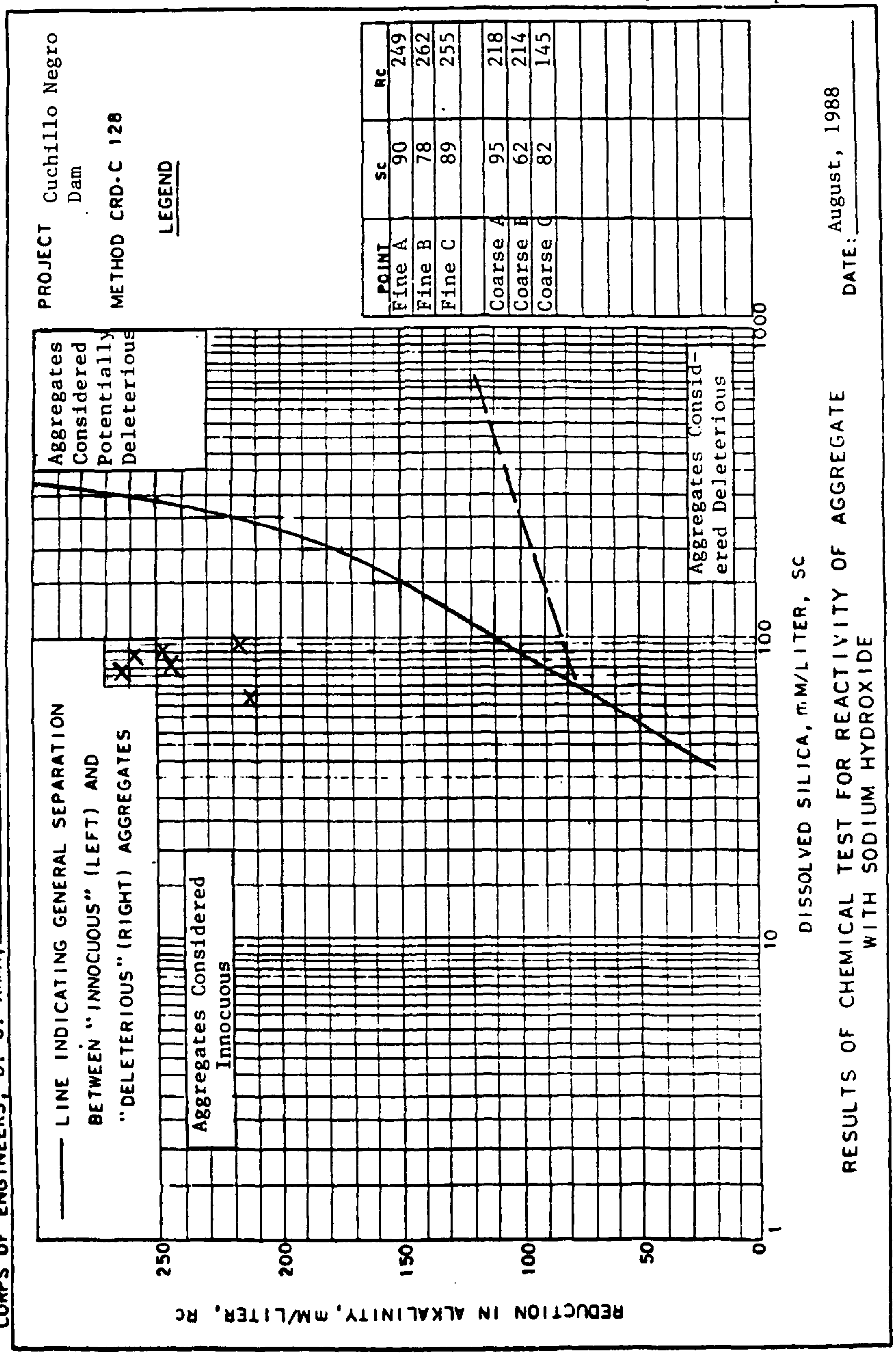


Sample C-1847-B before freezing and thawing.



Sample C-1847-B after 20 cycles of freezing and thawing.

PLATE 2



RESULTS OF CHEMICAL TEST FOR REACTIVITY OF AGGREGATE WITH SODIUM HYDROXIDE

Plate 3

Diamond Core Laboratory Test Results

FOX

FOX & ASSOCIATES OF NEW MEXICO, INC.

CONSULTING ENGINEERS AND GEOLOGISTS

ALBUQUERQUE OFFICE 3412 BRYN MAWR DRIVE, NE
ALBUQUERQUE, NEW MEXICO 87107
(505) 884-0900

August 13, 1984

Corps of Engineers
Construction Branch
P. O. Box 1580
Albuquerque, NM 87103

Job No. 434690

Attention: Mr. Don Luna

Subject: Laboratory Test Results for Cuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM0007

Gentlemen:

The results of the laboratory testing on the rock core for Cuchillo Negro Creek are presented on the attached table.

The remaining untested rock core is being held at our office pending further instructions.

If you have any questions, please contact our office.

FOX & ASSOCIATES OF NEW MEXICO, INC.

Steven L. Brewer
Staff Geologist

Reviewed by:

Melvin W. Miles
Area Manager

Copies: Addressee (2)

jcg

A FOX COMPANY

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Job No. 434690

Project: Cuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM0007

Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description
RCCH-1	20' to 22'	2.391	5.944	25,857	-	limestone, gray, fine-grained
RCCH-1	58' to 59'	2.392	5.900	21,096	2.60	limestone, gray, fine-grained
RCCH-1	69½' to 70'	2.392	6.192	6,698	-	shale, gray, limestone nodules
RCCH-1	71½' to 72'	2.392	5.955	7,188	2.67	shale, gray, limestone nodules
RCCH-1	74' to 75'	2.393	5.952	12,674	-	shale, gray, calcareous, chert and limestone
RCCH-1	78½' to 79'	2.393	5.842	9,294	-	limestone with shale partings, gray
RCCH-1	93'	2.387	6.481	4,626	2.53	shale, brown, calcareous
RCCH-2	40' to 41'	2.408	6.128	15,173	2.67	limestone, gray, crystalline
RCCH-2	56' to 57'	2.400	5.715	9,549	2.52	shale, dark gray, calcareous
RCCH-2	59' to 60'	2.366	5.709	4,253	2.50	limestone, gray, silty
RCCH-3	31'	2.392	5.970	28,617	2.71	limestone, red-brown, crystalline
RCCH-3	64' to 65'	2.391	5.960	4,900	-	shale and limestone, gray

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Job No. 434690

Project: Cuchillo Negro Creek (Item 0002)
DACW47-83-D-0023, Delivery Order #DM0007

Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description
RCCH-3	71'	2.398	6.012	13,241	-	limestone, gray, shale partings
RCCH-3	77' to 78'	2.387	6.041	6,749	2.65	shale, brown, calcareous

* Specimens coated with paraffin
**ASTM D 3148-72

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Project: Cuchill Negro Creek, Cuchillo Dam Site

Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description
CN-CH-1	20′ to 22′	2.391	5.944	25,857	-	limestone, gray, fine-grained
CN-CH-1	58′ to 59′	2.392	5.900	21,096	2.60	limestone, gray, fine-grained
CN-CH-1	69 1/2′ to 70′	2.392	6.192	6,698	-	shale, gray, limestone nodules
CN-CH-1	71 1/2′ to 72′	2.392	5.955	7,188	2.67	shale, gray, limestone nodules
CN-CH-1	74′ to 75′	2.393	5.952	12,674	-	shale, gray, calcareous chert and limestone
CN-CH-1	78 1/2′ to 79′	2.393	5.842	9,294	-	limestone with shale parting gray
CN-CH-1	93′	2.387	6.481	4,626	2.53	shale, brown, calcareous
CN-CH-2	40′ to 41′	2.408	6.128	15,173	2.67	limestone, gray, crystalline
CN-CH-2	56′ to 57′	2.400	5.715	9,549	2.52	shale, dark gray, calcareous
CN-CH-2	59′ to 60′	2.366	5.709	4,253	2.50	limestone, gray silty
CN-CH-3	31′	2.392	5.970	28,617	2.71	Limestone, red-brown, crystalline
CN-CH-3	64′ to 65′	2.391	5.960	4,900	-	shale and limestone, gray
CN-CH-3	71′	2.398	6.012	13,241	-	limestone, gray, shale partings
CN-CH-3	77′ to 78′	2.387	6.041	6,749	2.65	shale, brown, calcareous

* Specimens coated with paraffin
**ASTM D 3148-72

SUMMARY OF LABORATORY TEST RESULTS ON ROCK CORE

Project: Cuchill Negro Creek, Cuchillo Dam Site

Test Hole	Depth (ft.)	Core Diameter (Inches)	Core Length (Inches)	Unconfined Compressive Strength (psi)**	Bulk Dry Specific Gravity*	Description
CN-CH-9	10.5 - 11	2.401	6.101	19,065	2.62	limestone, fine-grained
CN-CH-9	41.0 - 41.5	2.397	5.873	10,461	2.57	limestone, argillaceous
CN-CH-10	20.5 - 21.0	2.400	5.730	17,468	2.60	limestone, fine-grained
CN-CH-10	36.5 - 37.0	2.393	6.113	9,864	2.55	shale, calcareous
CN-CH-11	14.0 - 14.5	2.407	5.790	18,727	2.61	limestone, fine-grained
CN-CH-11	33.0 - 34.0	2.397	6.130	17,647	2.61	limestone, fine-grained
CN-CH-12	15 - 16	2.403	5.831	14,069	-	limestone, argillaceous
CN-CH-12	33.0 - 33.5	2.399	6.140	9,711	-	shale, calcareous

* Specimens coated with paraffin
**ASTM D 3148-72

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Record#	HOLE	DEPTH	DIA	LEN	PSI	DEN	RK	MOD
1	CN-CH-1	20.0 - 22.0	2.391	5.944	25,857	---	LIMESTONE, FINE GRAINED	--
2	CN-CH-1	58.0 - 59.0	2.392	5.900	21,096	162.7	LIMESTONE, FINE GRAINED	--
3	CN-CH-1	69.5 - 70.0	2.392	6.192	6,698	---	SHALE, WITH LIMESTONE	--
4	CN-CH-1	71.5 - 72.0	2.393	5.955	7,188	167.1	SHALE, WITH LIMESTONE	--
5	CN-CH-1	74.0 - 75.0	2.393	5.952	12,674	---	SHALE,CALCAREOUS	--
6	CN-CH-1	78.5 - 79.0	2.393	5.842	9,294	---	LIMESTONE, SHALE PART.	--
7	CN-CH-1	93.0 - 94.0	2.387	6.481	4,626	158.3	SHALE, CALCAREOUS	--
8	CN-CH-2	40.0 - 41.0	2.408	6.128	15,173	167.1	LIMESTONE	--
9	CN-CH-2	56.0 - 57.0	2.400	5.715	9,549	157.7	SHALE, CALCAREOUS	--
10	CN-CH-2	59.0 - 60.0	2.366	5.709	4,253	156.4	LIMESTONE, ARGILLACEOUS	--
11	CN-CH-3	31.0 - 32.0	2.392	5.970	28,617	169.6	LIMESTONE	--
12	CN-CH-3	64.0 - 65.0	2.391	5.960	4,900	---	SHALE, LIMESTONE	--
13	CN-CH-3	71.0 - 72.0	2.398	6.012	13,241	---	LIMESTONE, SHALEY	--
14	CN-CH-3	77.0 - 78.0	2.387	6.041	6,749	165.8	SHALE, CALCAREOUS	--
15	CN-CH-9	10.5 - 11.0	2.401	6.101	19,065	163.9	LIMESTONE, FINE GRAINED	--
16	CN-CH-9	41.0 - 41.5	2.397	5.873	10,461	160.8	LIMESTONE, ARGILLACEOUS	--
17	CN-CH-10	20.5 - 21.0	2.40	5.730	17,468	162.7	LIMESTONE	--
18	CN-CH-10	36.5 - 37.0	2.393	6.113	9,864	159.5	SHALE, CALCAREOUS	--
19	CN-CH-11	14.0 - 14.5	2.407	5.790	18,727	163.3	LIMESTONE, FINE GRAINED	--
20	CN-CH-11	33.0 - 34.0	2.397	6.130	17,647	163.3	LIMESTONE, FINE GRAINED	--
21	CN-CH-12	15.0 - 16.0	2.403	5.831	14,069	---	LIMESTONE, ARGILLACEOUS	--
22	CN-CH-12	33.0 - 33.5	2.399	6.140	9,711	---	SHALE, CALCAREOUS	--
23	CN-CH-15	33.7-35.0	2.43	5.35	6,998	167.8	LIMESTONE,GRAY,HARD	4.71E+06
24	CN-CH-16	29.7-30.6	2.41	4.96	14,848	173.9	LIMESTONE,DK. GRAY,HARD	2.14E+07
25	CN-CH-16	42.1-43.4	2.43	4.99	16,459	173.4	LIMESTONE,GRAY,HARD	1.51E+07
26	CN-CH-17	30.0-31.0	2.64	4.71	6,587	166.9	LIMESTONE,LT. GRAY,HARD	6.12E+06
27	CN-CH-17	35.1-36.8	2.64	4.63	1,638	158.9	SHALE,BROWN,MOD. SOFT	1.32E+06
28	CN-CH-18	11.4-13.0	2.62	5.01	17,963	174.1	LIMESTONE,LT. GRAY,HARD	9.94E+06
29	CN-CH-18	25.0-26.3	2.62	4.93	19,220	172.6	LIMESTONE,GRAY,HARD	1.09E+07
30	CN-CH-19	32.4-33.9	2.44	4.88	5,553	171.9	LIMESTONE,GRAY,HARD	3.03E+06
31	CN-CH-19	45.6-47.3	2.44	4.80	5,299	172.4	LIMESTONE,GRAY,SL. WEA.	2.84E+06
32	CN-CH-20	7.0-8.4	2.66	4.84	14,025	172.3	LIMESTONE,MED.GRAY,HARD	4.19E+06

CUCHILLO NEGRO DAMSITE
SUMMARY OF UNCONFINED COMPRESSIVE STRE
OF ROCK CORE SAMPLES

HOLE NUMBER	DEPTH (FEET)	CORE DIAMETER (INCHES)	CORE LENGTH (INCHES)	UNCONFINED COMPRESSIVE STRENGTH (PSI)	DENSITY (PCF)	MODUL OF ELAST
CN-CH-1	20.0 - 22.0	2.391	5.944	25,857	---	--
CN-CH-1	58.0 - 59.0	2.392	5.900	21,096	162.7	--
CN-CH-1	69.5 - 70.0	2.392	6.192	6,698	---	--
CN-CH-1	71.5 - 72.0	2.393	5.955	7,188	167.1	--
CN-CH-1	74.0 - 75.0	2.393	5.952	12,674	---	--
CN-CH-1	78.5 - 79.0	2.393	5.842	9,294	---	--
CN-CH-1	93.0 - 94.0	2.387	6.481	4,626	158.3	--
CN-CH-2	40.0 - 41.0	2.408	6.128	15,173	167.1	--
CN-CH-2	56.0 - 57.0	2.400	5.715	9,549	157.7	--
CN-CH-2	59.0 - 60.0	2.366	5.709	4,253	156.4	--
CN-CH-3	31.0 - 32.0	2.392	5.970	28,617	169.6	--
CN-CH-3	64.0 - 65.0	2.391	5.960	4,900	---	--
CN-CH-3	71.0 - 72.0	2.398	6.012	13,241	---	--
CN-CH-3	77.0 - 78.0	2.387	6.041	6,749	165.8	--
CN-CH-9	10.5 - 11.0	2.401	6.101	19,065	163.9	--
CN-CH-9	41.0 - 41.5	2.397	5.873	10,461	160.8	--
CN-CH-10	20.5 - 21.0	2.40	5.730	17,468	162.7	--
CN-CH-10	36.5 - 37.0	2.393	6.113	9,864	159.5	--
CN-CH-11	14.0 - 14.5	2.407	5.790	18,727	163.3	--
CN-CH-11	33.0 - 34.0	2.397	6.130	17,647	163.3	--
CN-CH-12	15.0 - 16.0	2.403	5.831	14,069	---	--
CN-CH-12	33.0 - 33.5	2.399	6.140	9,711	---	--
CN-CH-15	33.7-35.0	2.43	5.35	6,998	167.8	4.71E
CN-CH-16	29.7-30.6	2.41	4.96	14,848	173.9	2.14E

CN-CH-16	42.1-43.4	2.43	4.99	16,459	173.4	1.51E
CN-CH-17	30.0-31.0	2.64	4.71	6,587	166.9	6.12E
CN-CH-17	35.1-36.8	2.64	4.63	1,638	158.9	1.32E
CN-CH-18	11.4-13.0	2.62	5.01	17,963	174.1	9.94E
CN-CH-18	25.0-26.3	2.62	4.93	19,220	172.6	1.09E
CN-CH-19	32.4-33.9	2.44	4.88	5,553	171.9	3.03E
CN-CH-19	45.6-47.3	2.44	4.80	5,299	172.4	2.84E
CN-CH-20	7.0-8.4	2.66	4.84	14,025	172.3	4.19E
CN-CH-21	7.8-8.5	2.60	4.28	12,068	165.2	4.32E
CN-CH-21	46.5-47.5	2.43	3.57	2,879	162.4	1.84E
CN-CH-21	74.5-75.4	2.40	4.63	3,267	167.6	3.11E
CN-CH-22	52.1-53.2	2.36	4.67	1,147	162.8	1.60E

Borehole Camera Surveys

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14683 (32 pages)

PROJECT: CUCHILLO NEGRO DAM SITE Feature: VIDEO INVESTIGATIONS OF SELECTED BOREHOLES	Contract No.
TEST REQUEST NO.: E8680027 Dated: 18 March 1988 Received: 25 March 1988	From: Chief Geotechnical Branch Albuquerque District

Identification:

BOREHOLES 1, 3, 15, 16, 17, 18 AND 20.

Dates: 23 through 25 March 1988

REMARKS:

SEE ATTACHED PAGES.

Report sent to: Albuquerque District	Copy furnished:

Date: 09 May 88	Name and title: WILLIAM R. TANNER Director SWD Laboratory	Signature Wm R Tanner

[illegible] LAB SITE
ALBUQUERQUE DISTRICT
VIDEO CAMERA INVESTIGATION
[illegible]-GL REPORT NO. 14683

1. REFERENCE: Reference is made to Albuquerque District test request E86880027, dated 18 March 1988, requesting video camera investigations of selected borings. The photography was performed during the week of 21 March 1988.

2. REMARKS: Attached are the results of the findings of this field investigation.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					Most of boring logged from side wall viewing camera. 0-5' - no casing - boring broken and enlarged from casing removal.
9.3	11.1		0.2500	Open	No Dip Direction Noted.
15.8	16.7		0.2500	Open	No Dip Direction Noted.
17.7	17.8	180.0	0.2500	Open	
35.2	36.0	180.0	0.0625	Healed	Light mineral filling.
37.4	37.9		0.0625	Healed	No Dip Direction Noted. Light mineral filling.
37.9	37.9				Top of cavity - rock missing - boring enlarged.
39.4	39.4				Bottom of cavity.
43.4	44.2		0.0313	Healed	No Dip Direction Noted. Light mineral filling.
44.2	45.3		0.2500	Open	No Dip Direction Noted.
45.5	46.9	240.0	0.0625	Healed	Light mineral filling.
48.0	48.9		0.0625	Healed	No Dip Direction Noted. Light mineral filling.
54.2	55.3	240.0	0.0625	Healed	
55.2	55.7	10.0	0.1250	Open	
57.5	57.5				Top of vertical fracture. tight, rock broken out by drilling action.
59.9	59.9				Bottom of vertical fracture.
64.9	64.9				Horizontal fracture, open, boring enlarged, cavity noted.
65.4	65.4				Bottom of cavity.
72.8	73.5	10.0	0.0313	Healed	Light mineral filling.
77.6	78.1	10.0	0.0625	Healed	Light mineral filling.
80.4	80.4				Top of cavity.
82.6	82.6				Bottom of cavity.
86.6	87.5		0.3500	Healed	No Dip Direction Noted. Light mineral filling.
89.4	89.9	315.0	0.0313	Healed	Light mineral filling.
89.6	90.5	330.0	0.0313	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (inches)	Joint Type	Remarks
91.6	91.6				End of videotaping, casing in boring.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
					Most of boring logged from side wall viewing camera. 0-5' - no casing - boring broken and enlarged from casing removal.
10.2		82.1	0.0342	Open	No Dip Direction Noted.
16.7		74.6	0.0665	Open	No Dip Direction Noted.
17.8	180.0	21.9	0.2319	Open	
35.6	180.0	72.8	0.0185	Healed	Light mineral filling.
37.7		63.6	0.0278	Healed	No Dip Direction Noted. Light mineral filling.
37.9					Top of cavity rock missing - boring enlarged -
39.4					Bottom of cavity.
43.8		72.8	0.0093	Healed	No Dip Direction Noted. Light mineral filling.
44.8		77.3	0.0551	Open	No Dip Direction Noted.
46.2	240.0	79.9	0.0109	Healed	Light mineral filling.
48.5		74.6	0.0166	Healed	No Dip Direction Noted. Light mineral filling.
54.8	240.0	77.3	0.0138	Healed	
55.5	10.0	63.6	0.0556	Open	
57.5					Top of vertical fracture. tight, rock broken out by drilling action.
59.9					Bottom of vertical fracture.
64.9					Horizontal fracture, open, boring enlarged, cavity noted,
65.4					Bottom of cavity.
73.2	10.0	70.5	0.0105	Healed	Light mineral filling.
77.8	10.0	63.6	0.0278	Healed	Light mineral filling.
80.4					Top of cavity.
82.6					Bottom of cavity.
87.1		74.6	0.0931	Healed	No Dip Direction Noted. Light mineral filling.
89.7	315.0	63.6	0.0139	Healed	Light mineral filling.
90.1	330.0	74.6	0.0083	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Ouchita Hydro Dam
Drill Hole Name : 1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
91.6					End of videotaping, casing in boring.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					Most of boring logged from side wall viewing camera.
4.0	4.0				Bottom of casing.
6.1	6.1				Water influx along horizontal healed fracture.
9.4	9.4		0.2500	Open	No Dip Direction Noted. Horizontal and partially open. Rock broken along fracture plane.
17.1	17.3	120.0	0.2500	Open	Partially open, rock broken along fracture plane.
18.0	18.2	280.0	0.2500	Open	Partially open, rock broken along fracture plane.
19.7	19.8	330.0	0.7500	Open	Rock broken out along fracture plane.
27.0	27.1		0.1250	Healed	No Dip Direction Noted.
27.2	27.2		0.0000	Tight	No Dip Direction Noted. Hortizontal and hairline.
28.3	28.4		0.0300	Open	No Dip Direction Noted.
28.3	29.5	90.0	0.1300	Open	Broken out by drilling action.
32.0	32.1		0.0000	Tight	No Dip Direction Noted. Hairline.
35.8	35.9		0.0000	Tight	No Dip Direction Noted. Hairline.
35.9	36.2	240.0	0.1700	Open	
36.3	36.3				Top of cavity, rock broken away from boring wall, boring enlarged.
37.3	37.3				Bottom of cavity.
49.9	49.9				Healed, horizontal fracture.
52.3	52.3				Top of slightly broken zone, boring slightly enlarged.
54.0	54.0				Bottom of slightly broken zone.
56.6	56.6				Top of broken zone, rock broken away from boring wall, boring enlarged.
64.0	64.0				Bottom of broken zone.
65.4	65.4				Water level.
66.7	67.3		0.1300	Open	No Dip Direction Noted.
68.5	68.7	10.0	0.0010	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Cochiti [illegible]
Drill Hole Name : 3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
71.4	71.4				Top of fracture zone, rock slightly broken, boring wall intact, no enlargement.
75.4	75.8		0.1900	Healed	No Dip Direction Noted. Filled with rock debris, recemented with white material.
76.5	76.9		0.4000	Healed	No Dip Direction Noted. Filled with mottled material.
77.1	77.1				Bottom of fracture zone, end of videotape.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
					Most of boring logged from side wall viewing camera.
4.0					Bottom of casing.
6.1					Water influx along horizontal healed fracture.
9.4		0.0	0.2500	Open	No Dip Direction Noted. Horizontal and partially open. Rock broken along fracture plane.
17.5	120.0	70.5	0.0836	Open	Partially open, rock broken along fracture plane.
18.1	280.0	38.8	0.1947	Open	Partially open, rock broken along fracture plane.
19.8	330.0	21.9	0.6957	Open	Rock broken out along fracture plane.
27.0		16.8	0.1197	Healed	No Dip Direction Noted.
27.2		0.0	0.0000	Tight	No Dip Direction Noted. Hortizontal and hairline.
28.3		16.8	0.0287	Open	No Dip Direction Noted.
28.9	90.0	78.3	0.0263	Open	Broken out by drilling action.
32.0		16.8	0.0000	Tight	No Dip Direction Noted. Hairline.
35.8		16.8	0.0000	Tight	No Dip Direction Noted. Hairline.
36.0	240.0	50.4	0.1084	Open	
36.3					Top of cavity, rock broken away from boring wall, boring enlarged.
37.3					Bottom of cavity.
49.9					Healed, horizontal fracture.
52.3					Top of slightly broken zone, boring slightly enlarged.
54.0					Bottom of slightly broken zone.
56.6					Top of broken zone, rock broken away from boring wall, boring enlarged.
64.0					Bottom of broken zone.
65.4					Water level.
67.0		67.5	0.0497	Open	No Dip Direction Noted.
68.6	10.0	38.8	0.0008	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
71.4					Top of fracture zone, rock slightly broken, boring wall intact, no enlargement.
75.6		58.2	0.1002	Healed	No Dip Direction Noted. Filled with rock debris, recemented with white material.
76.8		50.4	0.2551	Healed	No Dip Direction Noted. Filled with mottled material.
77.1					Bottom of fracture zone, end of videotape.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
31.8	31.8				Start videotape.
31.9	32.0	270.0	0.1250	Healed	Light mineral filling.
33.7	33.9	60.0	0.1250	Open	Partly filled with dark min.
34.0	34.5	260.0	0.0010	Healed	Hairline with light mineral filling.
38.3	38.5	60.0	0.2500	Healed	Light mineral filling.
39.1	40.0	225.0	0.1250	Healed	Light mineral filling.
41.7	42.5	260.0	0.0010	Healed	Hairline with light mineral filling.
47.6	48.3	270.0	0.0010	Healed	Hairline with light mineral filling.
47.8	47.8	0.0	0.0010	Healed	Hairline with light mineral filling.
49.4	50.3	260.0	0.0010	Healed	Hairline with light mineral filling.
55.3	56.0	220.0	0.0625	Open	Partly filled with lt min.
57.2	58.2	270.0	0.0010	Healed	Hairline with light mineral filling.
58.0	58.6	270.0	0.0010	Healed	Hairline with light mineral filling.
62.9	63.8	260.0	0.0625	Healed	Light mineral filling.
64.3	64.6	270.0	0.0625	Healed	Light mineral filling.
64.9	65.7	250.0	0.1250	Open	Partly filled with lt min.
65.4	65.4				Water level
65.8	66.0	45.0	0.1250	Open	Partly filled with lt min.
66.3	66.5	45.0	0.1250	Healed	Light mineral filling.
69.5	69.7	60.0	0.0020	Healed	Hairline with light mineral filling.
70.1	71.0	260.0	0.3750	Open	Partly filled with lt min.
70.7	71.8	260.0	0.1250	Healed	Light mineral filling.
76.0	76.0				Fracture zone, numerous fractures 1/16 inch wide.
77.0	77.0				Bottom of fracture zone.
77.6	79.0	225.0	0.0010	Healed	Hairline with light mineral filling.
77.8	78.0	60.0	0.0010	Open	Hairline.
78.2	78.3	60.0	0.0010	Healed	Hairline with light mineral filling.
78.3	78.5	60.0	0.0010	Healed	Complex and hairline with light mineral filling.
78.6	78.8	60.0	0.0010	Healed	Hairline with light mineral filling.
78.9	79.1	60.0	0.0010	Healed	Hairline with light mineral filling.
79.2	79.6	60.0	0.0010	Healed	Hairline with light mineral filling.
79.4	79.4	0.0	0.0010	Healed	Horizontal and hairline with light mineral filling.
79.5	79.8	60.0	0.0010	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
80.0	80.0				End of videotapeing.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
31.8					Start videotape.
32.0	270.0	17.6	0.1191	Healed	Light mineral filling.
33.8	60.0	32.4	0.1055	Open	Partly filled with dark min.
34.3	260.0	57.8	0.0005	Healed	Hairline with light mineral filling.
38.4	60.0	32.4	0.2111	Healed	Light mineral filling.
39.5	225.0	70.7	0.0413	Healed	Light mineral filling.
42.1	260.0	68.5	0.0004	Healed	Hairline with light mineral filling.
48.0	270.0	65.8	0.0004	Healed	Hairline with light mineral filling.
47.8	0.0	0.0	0.0010	Healed	Hairline with light mineral filling.
49.8	260.0	70.7	0.0003	Healed	Hairline with light mineral filling.
55.7	220.0	65.8	0.0257	Open	Partly filled with lt min.
57.7	270.0	72.5	0.0003	Healed	Hairline with light mineral filling.
58.3	270.0	62.3	0.0005	Healed	Hairline with light mineral filling.
63.3	260.0	70.7	0.0207	Healed	Light mineral filling.
64.4	270.0	43.6	0.0453	Healed	Light mineral filling.
65.3	250.0	68.5	0.0458	Open	Partly filled with lt min.
65.4					water level
65.9	45.0	32.4	0.1055	Open	Partly filled with lt min.
66.4	45.0	32.4	0.1055	Healed	Light mineral filling.
65.6	60.0	32.4	0.0017	Healed	Hairline with light mineral filling.
70.6	260.0	70.7	0.1239	Open	Partly filled with lt min.
71.3	260.0	74.0	0.0344	Healed	Light mineral filling.
76.0					Fracture zone, numerous fractures 1/16 inch wide.
77.0					Bottom of fracture zone.
78.3	225.0	77.3	0.0002	Healed	Hairline with light mineral filling.
77.9	60.0	32.4	0.0008	Open	Hairline.
73.3	60.0	17.6	0.0010	Healed	Hairline with light mineral filling.
79.4	60.0	32.4	0.0008	Healed	Complex and hairline with light mineral filling.
78.7	60.0	32.4	0.0008	Healed	Hairline with light mineral filling.
79.0	60.0	32.4	0.0008	Healed	Hairline with light mineral filling.
79.4	60.0	51.8	0.0006	Healed	Hairline with light mineral filling.
79.4	0.0	0.0	0.0010	Healed	Horizontal and hairline with light mineral filling.
79.7	60.0	43.6	0.0007	Healed	Hairline with light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 15
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
80.0					End of videotapeing.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 16
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
30.8	30.8				Start videotape.
31.0	31.0				Bottom of casing.
34.2	34.2				Cavity, rock broken back, boring enlarged.
34.4	34.4				Bottom of cavity.
36.2	37.1	225.0	0.0010	Healed	Hairline with light mineral filling.
44.0	44.2	210.0	0.0010	Healed	Hairline with light mineral filling.
45.7	46.5	240.0	0.2500	Open	Partly filled with lt min.
50.5	51.3	225.0	0.0010	Healed	Hairline with light mineral filling.
57.9	58.1	45.0	0.0010	Healed	Hairline with dark mineral filling.
59.7	60.0	45.0	0.0020	Healed	Hairline with dark mineral filling.
60.7	61.3	270.0	0.0010	Healed	Hairline with dark mineral filling.
62.8	63.7	260.0	0.0010	Healed	Hairline with dark mineral filling.
76.3	77.2	225.0	0.0020	Healed	Hairline with light mineral filling.
78.8	79.5	225.0	0.1250	Healed	Dark Mineral filling.
94.1	94.9	225.0	0.1250	Open	Partly filled with lt min.
105.0	105.3	60.0	0.0020	Healed	Hairline with light mineral filling.
106.5	106.5				Water level.
106.6	106.7	15.0	0.0010	Healed	Hairline with light mineral filling.
106.7	106.8	15.0	0.0010	Healed	Hairline with light mineral filling.
106.9	108.1	225.0	0.7500	Healed	Light mineral filling.
109.4	109.5	60.0	0.0010	Healed	Hairline with light mineral filling.
109.0	111.5	180.0	0.0010	Healed	Hairline with light mineral filling.
112.0	112.0				Top of fracture zone, fractures range from hairline to 1/8 inch wide, dip direction 150 degrees, angle of 60.
117.3	117.3				Bottom of fracture zone.
117.9	117.9				End of videotaping.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 16
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
30.8					Start videotape.
31.0					Bottom of casing.
34.2					Cavity, rock broken back, boring enlarged.
34.4					Bottom of cavity.
36.7	125.0	70.7	0.0003	Healed	Hairline with light mineral filling.
44.1	210.0	32.4	0.0008	Healed	Hairline with light mineral filling.
46.1	240.0	56.5	0.0716	Open	Partly filled with lt min.
50.9	225.0	68.5	0.0004	Healed	Hairline with light mineral filling.
58.0	45.0	32.4	0.0008	Healed	Hairline with dark mineral filling.
59.8	45.0	43.6	0.0014	Healed	Hairline with dark mineral filling.
61.0	270.0	62.3	0.0005	Healed	Hairline with dark mineral filling.
63.3	250.0	70.7	0.0005	Healed	Hairline with dark mineral filling.
76.8	125.0	70.7	0.0007	Healed	Hairline with light mineral filling.
79.2	225.0	65.8	0.0513	Healed	Dark Mineral filling.
94.5	125.0	59.5	0.0459	Open	Partly filled with lt min.
105.2	60.0	43.6	0.0014	Healed	Hairline with light mineral filling.
106.5					Water level.
106.7	15.0	17.6	0.0010	Healed	Hairline with light mineral filling.
106.9	15.0	17.6	0.0010	Healed	Hairline with light mineral filling.
107.5	225.0	75.3	0.1905	Healed	Light mineral filling.
109.4	60.0	17.6	0.0010	Healed	Hairline with light mineral filling.
110.3	180.0	82.8	0.0001	Healed	Hairline with light mineral filling.
112.0					Top of fracture zone, fractures range from hairline to 1/8 inch wide, dip direction 150 degrees, angle of 60.
117.3					Bottom of fracture zone.
117.9					End of videotaping.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 17
Drill Hole Size : HD
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
19.1	19.1				Begin videotape.
22.2	22.2				Bottom of casing.
35.9	37.3	60.0	0.2000	Open	Surrounding rock slightly broken.
37.2	37.4	90.0	0.2500	Open	North side of boring wall broken out
38.4	38.6	90.0	0.0010	Healed	Tight
39.5	39.5				Top of broken area, north side of boring broken out, probably due to drilling action.
40.8	40.8				Bottom of broken area.
43.2	43.2				Top of rough and slightly broken area.
44.0	44.0				Bottom of rough and slightly broken area.
48.9	49.1	0.0	0.0010	Healed	Tight.
49.3	50.3	270.0	0.0010	Healed	Tight.
54.3	54.8	270.0	0.0625	Open	Partially filled, rock broken along fracture plane.
55.1	55.2	90.0	0.0010	Tight	Hairline.
55.2	56.9	90.0	0.0010	Tight	Hairline.
55.5	58.4	210.0	0.1250	Open	Partially healed to open. 1/4 inch healed to 1/4 inch open.
57.9	58.9	10.0	0.0010	Healed	Light mineral filling.
61.4	62.4	80.0	0.0625	Healed	Light mineral filling.
64.8	64.8				Water level.
64.1	65.4	290.0	0.0625	Healed	Light mineral filling.
64.3	66.0	300.0	0.0625	Healed	Light mineral filling.
65.8	65.9	45.0	0.0625	Healed	Light mineral filling.
67.6	67.7	45.0	0.0625	Healed	Light mineral filling.
67.9	68.1	0.0	0.0625	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : [illegible] Dam
Drill Hole Name : [illegible]
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
19.1					Begin videotape.
22.2					Bottom of casing.
36.6	60.0	77.3	0.0439	Open	Surrounding rock slightly broken.
37.3	90.0	31.4	0.2111	Open	North side of boring wall broken out
38.5	90.0	31.4	0.0008	Healed	Tight
39.5					Top of broken area, north side of boring broken out. probably due to drilling action.
40.8					Bottom of broken area.
43.2					Top of rough and slightly broken area.
44.0					Bottom of rough and slightly broken area.
49.6	0.0	32.4	0.0008	Healed	Tight.
49.8	270.0	72.5	0.0003	Healed	Tight.
54.5	270.0	57.8	0.0333	Open	Partially filled, rock broken along fracture plane.
55.2	90.0	17.6	0.0010	Tight	Hairline.
56.0	90.0	79.5	0.0002	Tight	Hairline.
57.0	210.0	83.9	0.0135	Open	Partially healed to open. 1/4 inch healed to 1/4 inch open.
58.4	10.0	72.5	0.0003	Healed	Light mineral filling.
61.9	80.0	72.5	0.0188	Healed	Light mineral filling.
64.8					Water level.
64.8	290.0	76.4	0.0147	Healed	Light mineral filling.
65.2	300.0	79.5	0.0114	Healed	Light mineral filling.
65.8	45.0	17.6	0.0596	Healed	Light mineral filling.
67.7	45.0	17.6	0.0596	Healed	Light mineral filling.
68.0	0.0	32.4	0.0528	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 18
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
14.0	14.4	315.0	1.5000	Open	Broken back from hole wall.
16.2	16.3	60.0	1.1250	Open	Broken back from hole wall.
19.9	19.9				Top of broken zone.
24.3	24.3				Bottom of broken zone.
27.1	27.3	90.0	0.0010	Healed	Light mineral filling.
27.7	27.9	0.0	2.0000	Open	Broken back from hole wall.
28.9	29.0	270.0	0.1500	Open	Partly filled with lt min.
35.0	35.0				Top of broken zone.
38.1	38.1				Bottom of broken zone, appears open.
40.6	41.4	135.0	0.0010	Healed	Light mineral filling.
41.9	41.9	195.0	0.0010	Healed	Light mineral filling.
42.8	42.8	330.0	0.0010	Healed	Light mineral filling.
43.3	44.3	270.0	0.0010	Healed	Light mineral filling.
44.1	44.8	170.0	0.0010	Healed	Light mineral filling, discontinuous.
46.4	46.5	45.0	0.7500	Healed	Light mineral filling, irregular.
46.4	47.0	200.0	0.0625	Healed	Light mineral filling, discontinuous.
53.3	53.4	45.0	1.0000	Healed	Broken, brecciated zone.
53.6	53.9	40.0	0.0010	Healed	Light mineral filling.
54.1	54.1				Vertical fracture, irregular, discontinuous, 1/4 inch to 1 inch wide, healed with light mineral filling.
55.8	55.8	0.0	0.0010	Healed	Zone of about 5 horizontal fractures with light mineral filling, irregular.
59.9	60.1	75.0	1.5000	Healed	Light mineral filling.
62.3	62.6	50.0	0.0010	Healed	Light mineral filling.
62.5	62.5				Water level.
62.8	63.2	240.0	0.0010	Healed	Light mineral filling.
63.2	63.5	270.0	0.0010	Healed	Complex fracture with light mineral filling.
64.7	64.9	45.0	0.0010	Healed	Light mineral filling.
65.7	66.1	270.0	0.0010	Healed	Light mineral filling.
69.0	69.0				Hairline, tight, vertical fracture noted, discontinuous, exact orientation unavailable.
69.2	70.3	180.0	1.0000	Healed	Light mineral filling.
70.1	70.9	270.0	0.0010	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : [illegible]
Drill Hole Name : 16
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
73.3	73.3	0.0	0.0010	Healed	Horizontal with light mineral filling.
74.6	75.1	270.0	0.0010	Healed	Light mineral filling.
75.2	75.3	30.0	0.0300	Open	
75.3	75.8	30.0	0.0010	Healed	Light mineral filling.
75.8	76.0	30.0	0.0010	Healed	Light mineral filling.
77.9	78.1	30.0	0.0300	Healed	Light mineral filling.
78.3	79.3	270.0	0.2500	Healed	Light mineral filling.
79.3	80.7	60.0	0.0010	Healed	Light mineral filling.
87.4	87.8	150.0	0.0010	Healed	Light mineral filling.
92.9	92.9				Broken zone, rock broken back from boring wall, appears rough.
94.0	94.0				Bottom of broken zone.
94.1	94.1	0.0	0.5000	Open	Horizontal, 1/4 to 1/2 inch wide.
100.7	*102.0	160.0	0.0300	Open	Partly filled with light and dark mineral filling.
102.2	102.2	0.0	0.0010	Open	Horizontal, partly filled with dark min.
105.5	105.5				End videotape.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 18
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
14.2	315.0	51.8	0.9283	Open	Broken back from hole wall.
16.3	60.0	17.6	1.0723	Open	Broken back from hole wall.
19.9					Top of broken zone.
24.3					Bottom of broken zone.
27.2	90.0	32.4	0.0008	Healed	Light mineral filling.
27.8	0.0	32.4	1.6887	Open	Broken back from hole wall.
28.5	270.0	74.0	0.0413	Open	Partly filled with lt min.
35.0					Top of broken zone.
38.1					Bottom of broken zone, appears open.
41.1	135.0	62.3	0.0005	Healed	Light mineral filling.
41.4	195.0	72.5	0.0003	Healed	Light mineral filling.
41.8	330.0	81.0	0.0002	Healed	Light mineral filling.
43.8	270.0	72.5	0.0003	Healed	Light mineral filling.
44.5	170.0	65.8	0.0004	Healed	Light mineral filling, discontinuous.
46.5	45.0	17.6	0.7149	Healed	Light mineral filling, irregular.
46.7	200.0	62.3	0.0291	Healed	Light mineral filling, discontinuous.
53.3	45.0	17.6	0.9532	Healed	Broken, brecciated zone.
53.8	40.0	43.6	0.0007	Healed	Light mineral filling.
54.1					Vertical fracture, irregular, discontinuous, 1/4 inch to 1 inch wide, healed with light mineral filling.
55.8	0.0	0.0	0.0010	Healed	Zone of about 5 horizontal fractures with light mineral filling, irregular.
60.0	75.0	32.4	1.2665	Healed	Light mineral filling.
62.5	50.0	43.6	0.0007	Healed	Light mineral filling.
62.5					Water level.
63.0	240.0	51.8	0.0006	Healed	Light mineral filling.
63.3	270.0	43.6	0.0007	Healed	Complex fracture with light mineral filling.
64.8	45.0	32.4	0.0008	Healed	Light mineral filling.
65.9	270.0	51.8	0.0006	Healed	Light mineral filling.
69.0					Hairline, tight, vertical fracture noted, discontinuous, exact orientation unavailable.
69.8	180.0	74.0	0.2754	Healed	Light mineral filling.
70.5	270.0	68.5	0.0004	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 18
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
73.3	0.0	0.0	0.0010	Healed	Horizontal with light mineral filling.
74.8	270.0	57.5	0.0005	Healed	Light mineral filling.
75.3	30.0	17.6	0.0286	Open	
75.6	30.0	57.8	0.0005	Healed	Light mineral filling.
75.9	30.0	32.4	0.0008	Healed	Light mineral filling.
78.0	30.0	32.4	0.0253	Healed	Light mineral filling.
78.8	270.0	72.5	0.0751	Healed	Light mineral filling.
80.1	60.0	57.8	0.0005	Healed	Light mineral filling.
85.6	150.0	85.9	0.0001	Healed	Light mineral filling.
92.9					Broken zone, rock broken back from boring wall, appears rough.
94.0					Bottom of broken zone.
94.1	0.0	0.0	0.5000	Open	Horizontal, 1/4 to 1/2 inch wide.
101.3	160.0	76.4	0.0071	Open	Partly filled with light and dark mineral filling.
102.2	0.0	0.0	0.0010	Open	Horizontal, partly filled with dark min.
109.5					End videotape.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					Boring logged with front view camera, no orientations available.
0.0	0.0				Begin videotape, top of casing.
29.8	29.8				Bottom of casing, top of highly broken zone, boring enlarged.
31.5	31.8		0.0010	Healed	Filled with light mineral, two fractures intersect at right angles. 45 degrees to borehole.
52.2	52.2				Bottom of highly broken zone.
52.3	52.3				Top of broken zone.
52.7	52.7				Bottom of broken zone.
53.4	53.4		0.5000	Open	Horizontal, rock broken along fracture plane.
53.6	53.7		0.1250	Healed	Light mineral filling.
53.7	53.7		0.5000	Open	Horizontal, rock broken along fracture plane.
53.8	53.9		0.1250	Healed	Light mineral filling.
53.9	54.3		0.5000	Open	Rock broken along fracture plane.
54.3	54.5		0.2500	Open	Partly filled with lt min.
54.5	54.5				Top of highly broken zone, boring enlarged.
56.6	56.6				Bottom of broken zone.
57.0	57.0				Top of highly broken zone, boring enlarged.
60.7	60.7				Bottom of broken zone.
61.0	61.0				Top of slightly broken zone, boring enlarged.
61.4	61.4				Bottom of slightly broken zone.
61.7	61.7				Top of moderately broken zone, boring enlarged.
62.1	62.3		0.0010	Healed	Dark Mineral filling.
62.6	62.6				Top of highly broken zone, boring greatly enlarged.
66.6	66.6				Bottom of highly broken zone.
66.5	66.6		0.1250	Healed	Light mineral filling.
66.7	66.8		0.1250	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 20
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Fracture	Depth to Bottom of Fracture	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
67.9	67.9				Top of highly broken zone, boring enlarged.
68.9	69.2		0.0010	Healed	Dark Mineral filling.
69.3	69.5		0.0010	Healed	Dark Mineral filling.
70.1	70.1				Bottom of highly broken zone.
71.6	71.6				Top of highly broken zone, boring enlarged.
71.8	72.2		0.0010	Closed	Tight.
72.2	72.6		0.0010	Closed	Tight.
77.8	77.8				Bottom of highly broken zone.
80.4	80.4				Top of highly broken zone, boring
0.0	0.0				enlarged.
81.6	81.6				Bottom of highly broken zone.
82.2	82.2				Top of broken zone - boring enlarged.
85.0	85.0				Water cloudy, unable to see.
87.1	87.1				End videotape.

BOREHOLE ANALYSIS
Output Data

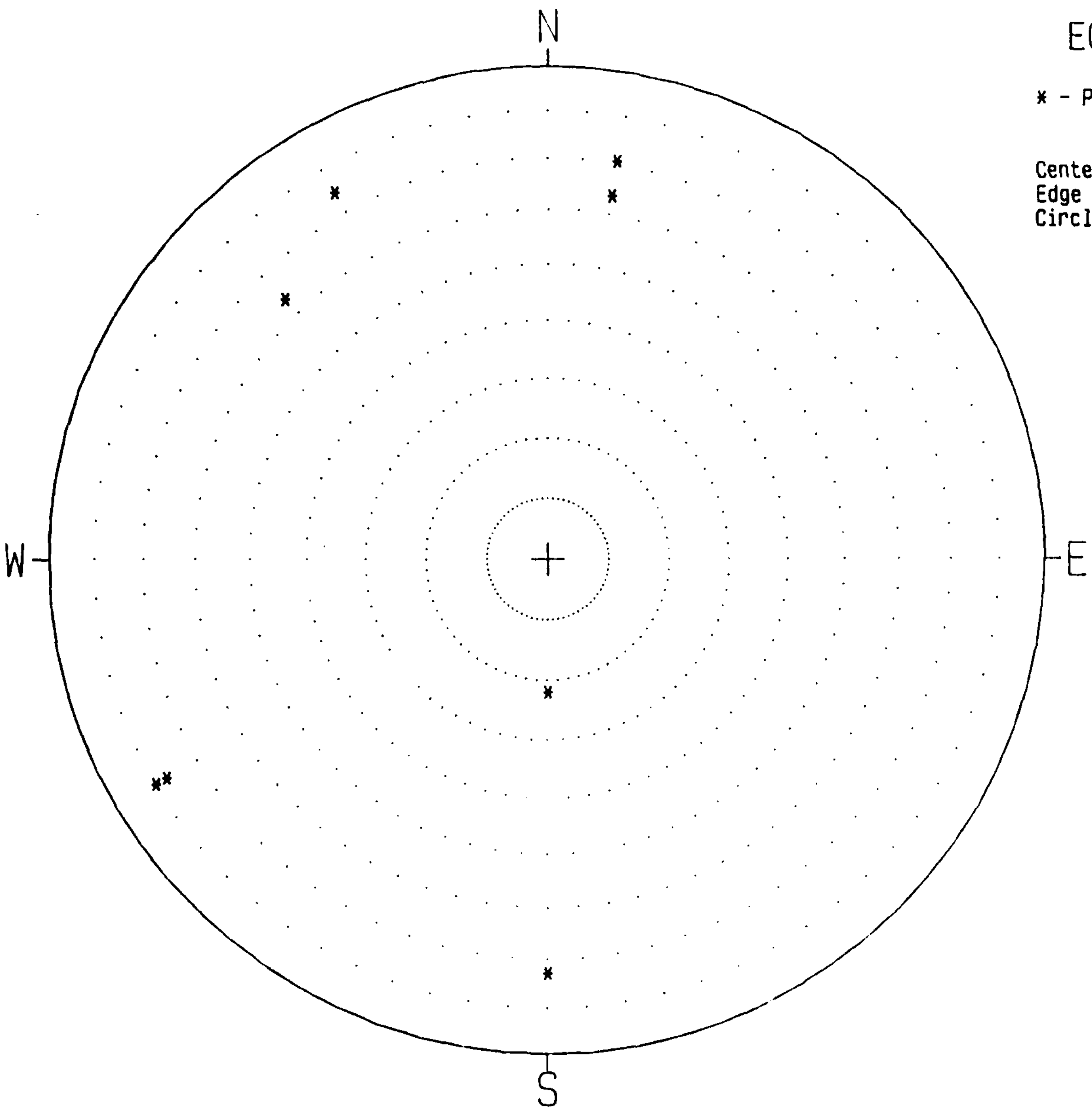
Project Name : Cuchillo Negro Dam
Drill Hole Name : 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
					Boring logged with front view camera, no orientations available.
0.0					Begin videotape, top of casing.
29.9					Bottom of casing, top of highly broken zone, boring enlarged.
31.6		43.6	0.0007	Healed	Filled with light mineral, two fractures intersect at right angles. 45 degrees to borehole.
52.2					Bottom of highly broken zone.
52.3					Top of broken zone.
52.7					Bottom of broken zone.
53.4		0.0	0.5000	Open	Horizontal, rock broken along fracture plane.
53.7		17.6	0.1191	Healed	Light mineral filling.
53.7		0.0	0.5000	Open	Horizontal, rock broken along fracture plane.
53.8		17.6	0.1191	Healed	Light mineral filling.
54.1		51.8	0.3094	Open	Rock broken along fracture plane.
54.4		32.4	0.2111	Open	Partly filled with lt min.
54.5					Top of highly broken zone, boring enlarged.
56.6					Bottom of broken zone.
57.0					Top of highly broken zone, boring enlarged.
60.7					Bottom of broken zone.
61.0					Top of slightly broken zone, boring enlarged.
61.4					Bottom of slightly broken zone.
61.7					Top of moderately broken zone, boring enlarged.
62.2		32.4	0.0008	Healed	Dark Mineral filling.
62.6					Top of highly broken zone, boring greatly enlarged.
66.6					Bottom of highly broken zone.
66.6		17.6	0.1191	Healed	Light mineral filling.
66.8		17.6	0.1191	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Fracture	Dip Direction of Fracture	Dip of Fracture	Width of Fracture (Inches)	Joint Type	Remarks
67.9					Top of highly broken zone, boring enlarged.
68.1		43.6	0.0007	Healed	Dark Mineral filling.
69.4		32.4	0.0008	Healed	Dark Mineral filling.
70.1					Bottom of highly broken zone.
71.6					Top of highly broken zone, boring enlarged.
72.1		57.8	0.0005	Closed	Tight.
72.4		43.6	0.0007	Closed	Tight.
77.8					Bottom of highly broken zone.
80.4					Top of highly broken zone, boring
[illegible].0					enlarged.
81.6					Bottom of highly broken zone.
52.2					Top of broken zone - boring enlarged.
85.[illegible]					Water cloudy, unable to see.
87.1					End videotape.

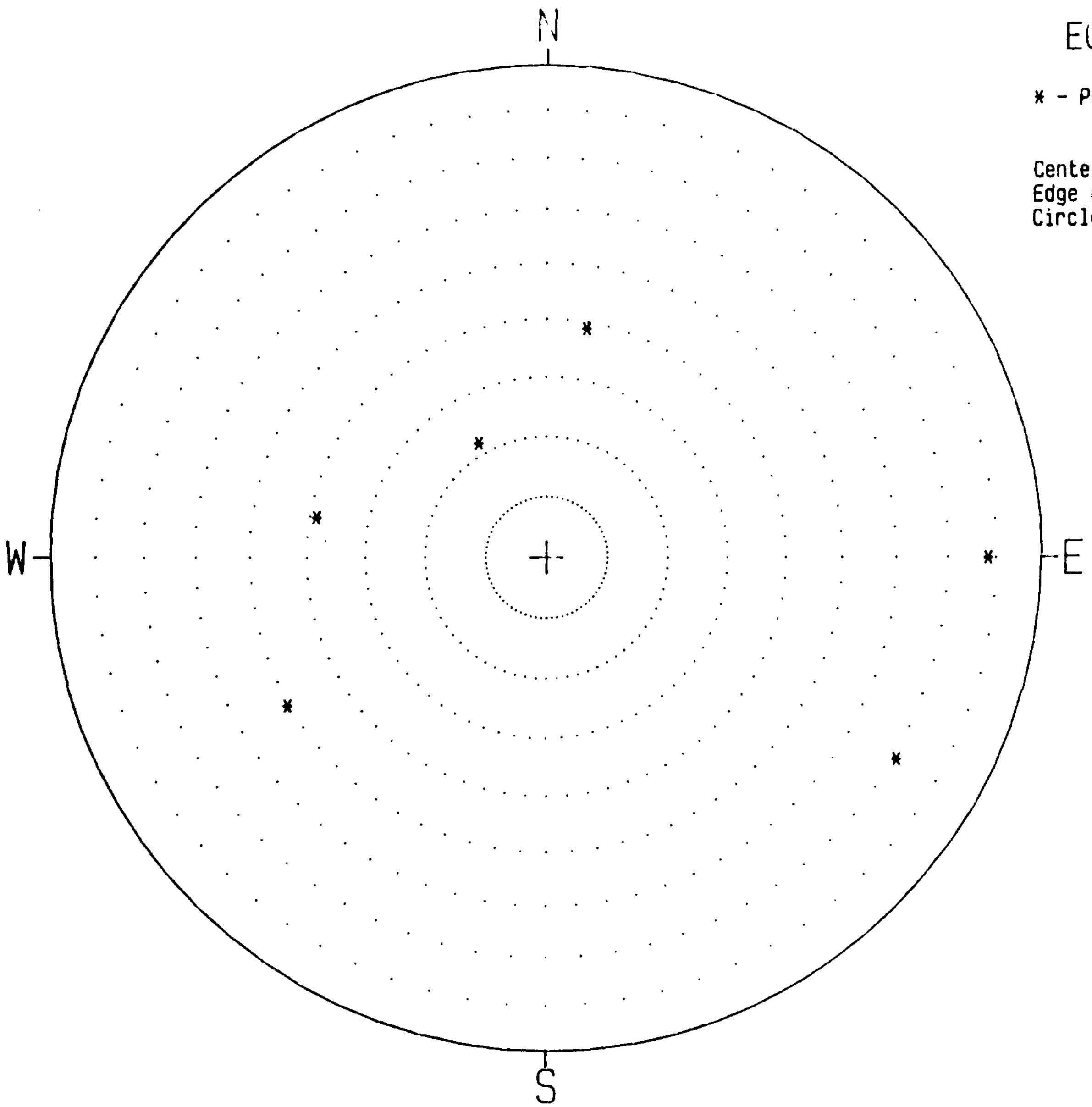


EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : Cuchillo Negro Dam	
Drill Hole : 1	Hole Size : NX
Orientation : Vertical	
Direction : 0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	

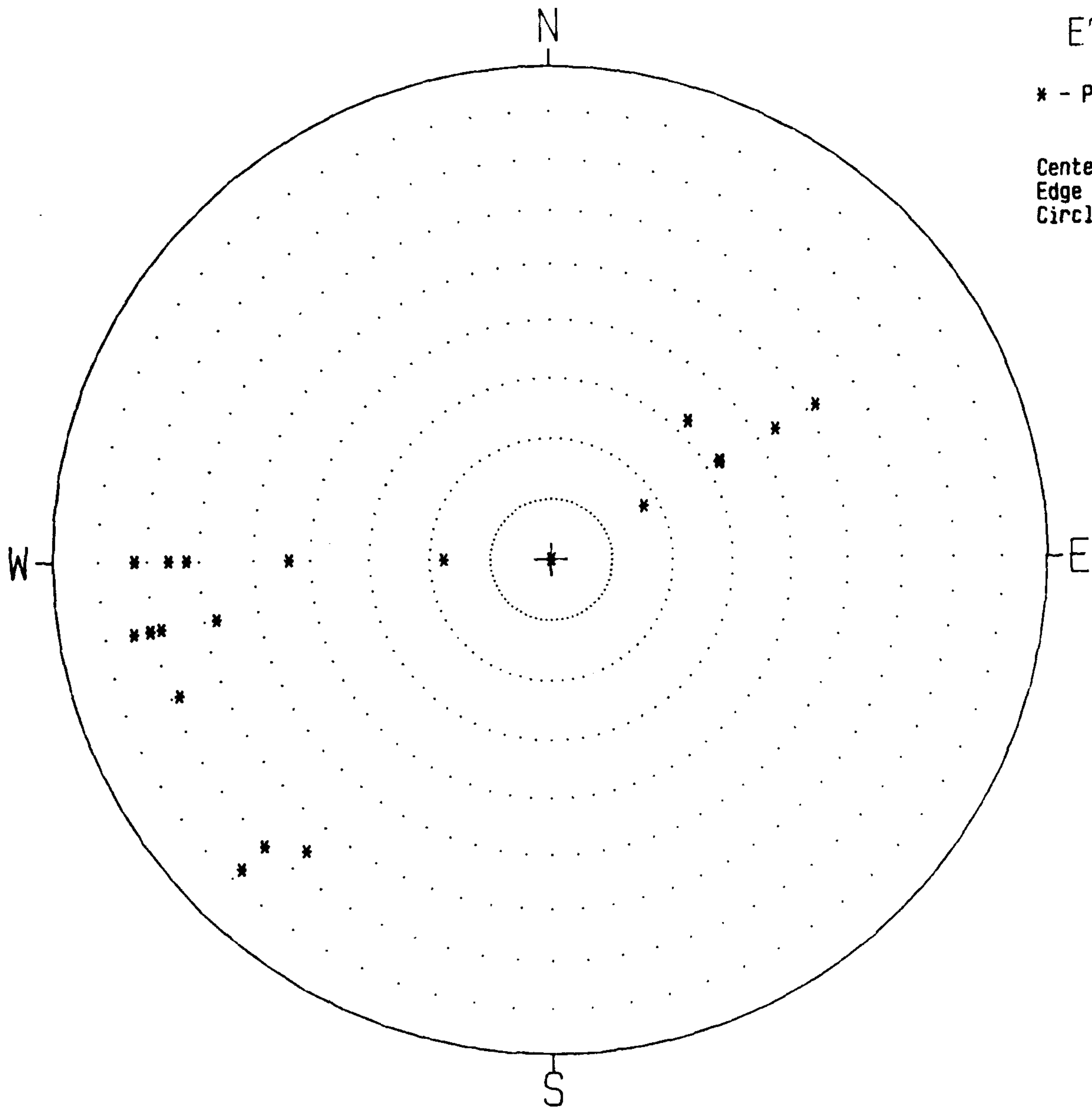


EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : Cuchillo Negro Dam	
Drill Hole : 3	Hole Size : NX
Orientation : Vertical	
Direction : 0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	



EQUAL AREA POLAR PLOT

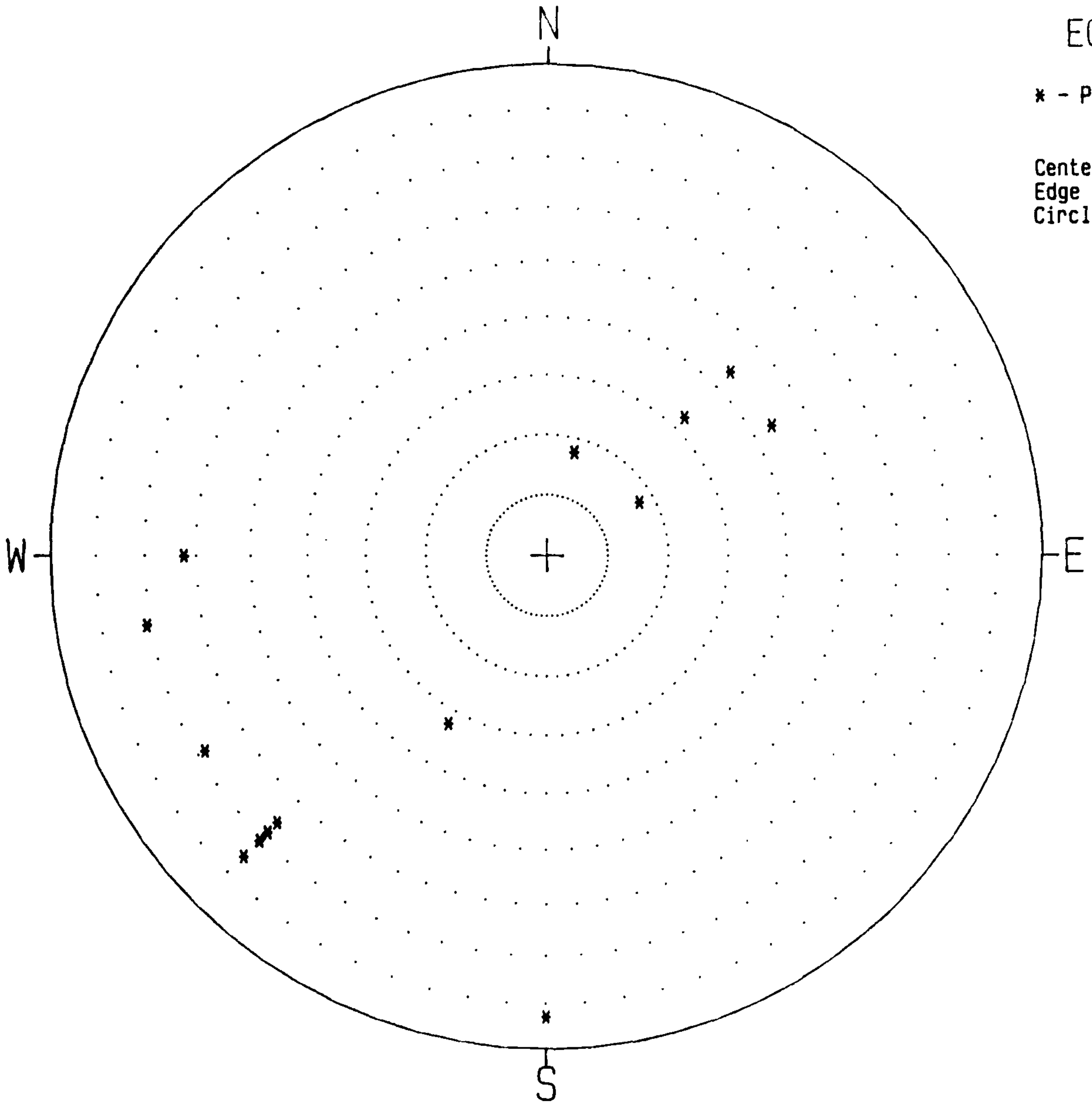
* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : Cuchillo Negro Dam

Drill Hole : 15 Hole Size : HQ
Orientation : Vertical
Direction : 0 Hade : 0

Photographed and Interpreted by the Southwest Division Lab



EQUAL AREA POLAR PLCT

* - Pole representing dip direction
and dip of planar features.

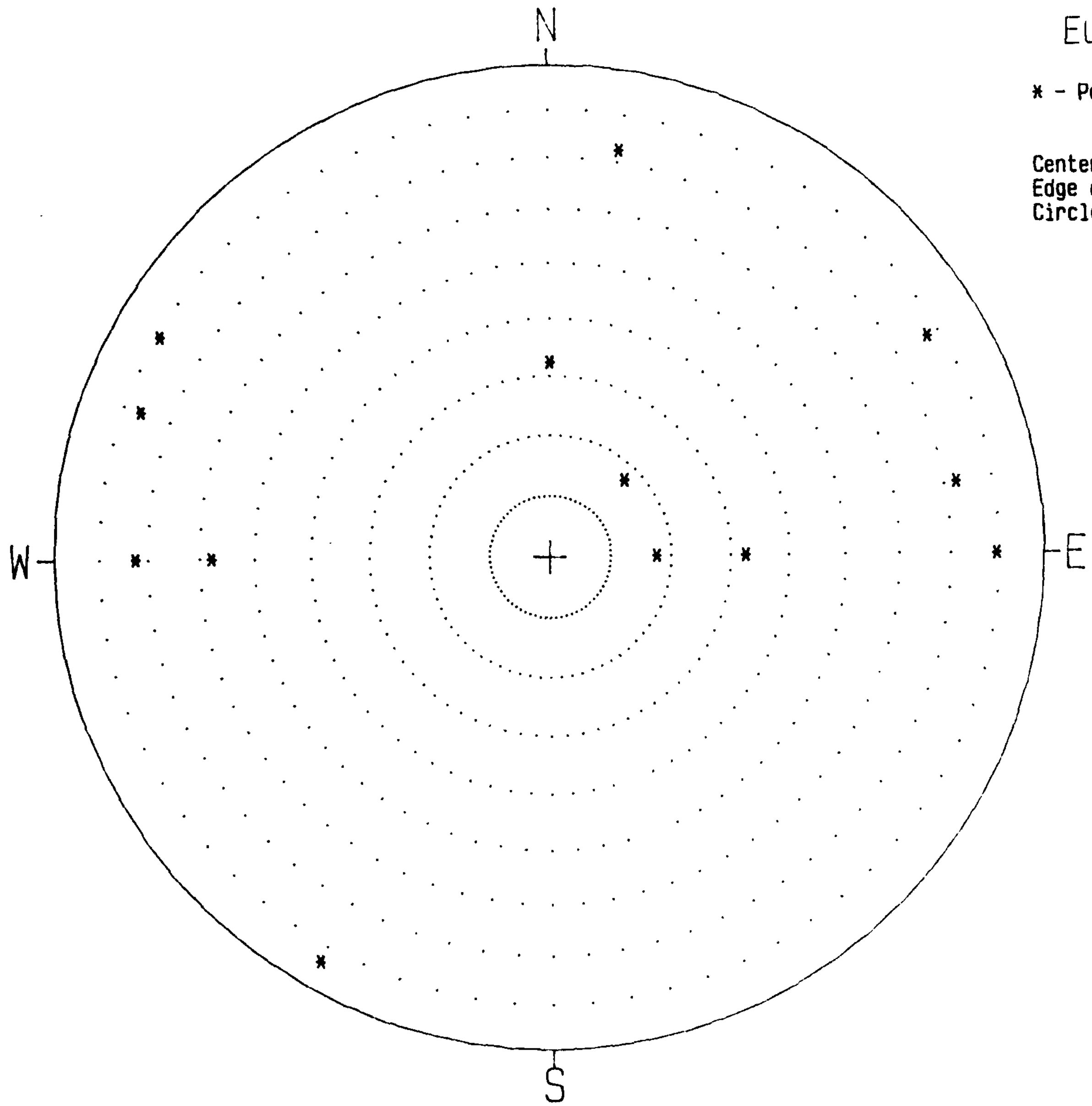
Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : Cuchillo Negro Dam
Drill Hole : 16 Hole Size : HQ Orientation : Vertical Direction : 0 Hade : 0
Photographed and Interpreted by the Southwest Division Lab

EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

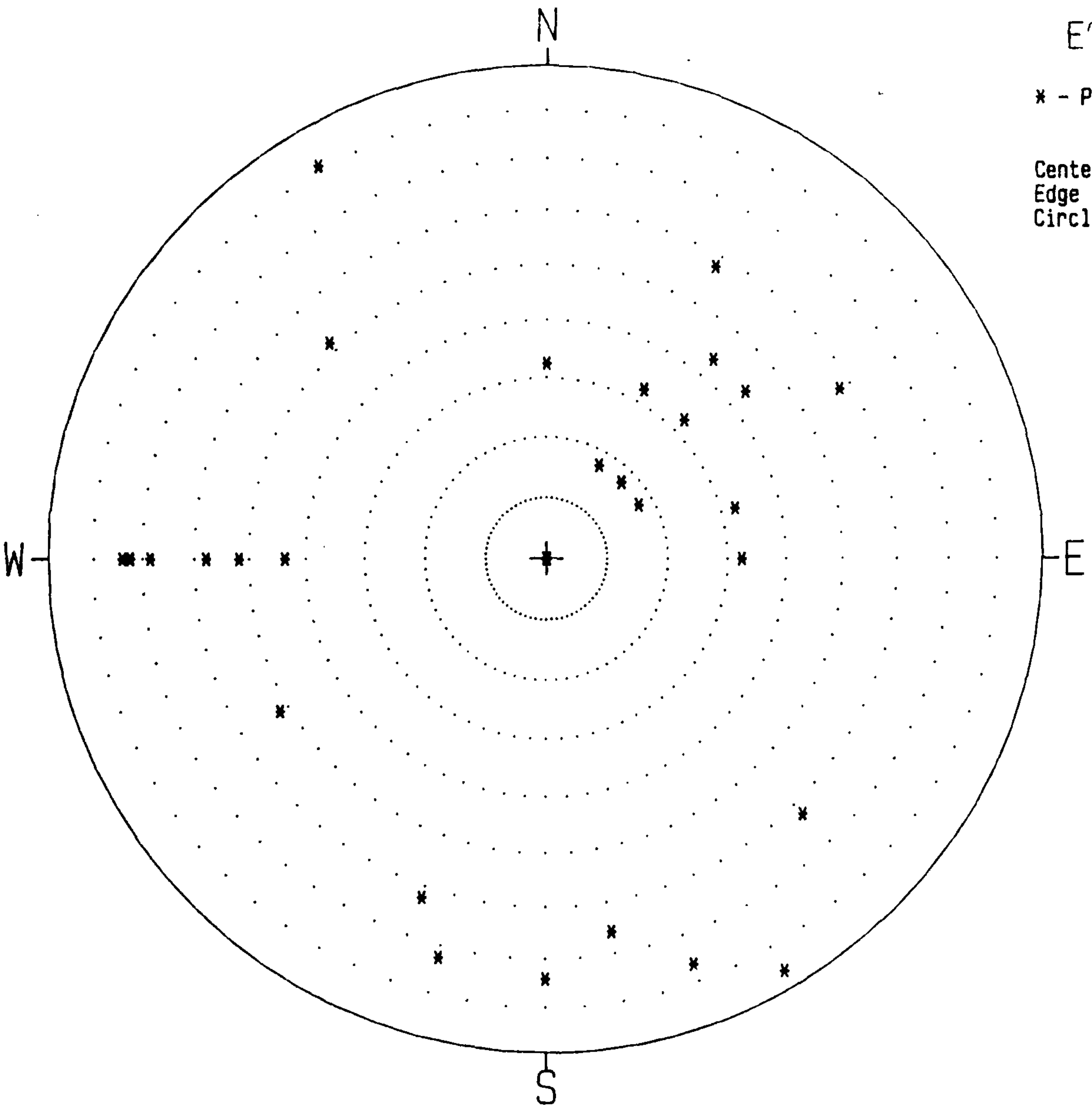


Project Name : Cuchillo Negro Dam	
Drill Hole : 17	Hole Size : HQ
Orientation : Vertical	
Direction : 0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : Cuchillo Negro Dam	
Drill Hole : 18	Hole Size : HQ
Orientation : Vertical	
Direction : 0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14683-1 (6 pages)

PROJECT: CUCHILLO NEGRO DAM SITE Feature: VIDEO INVESTIGATIONS OF SELECTED BOREHOLES	Contract No.
TEST REQUEST NO.: E8680027 Dated: 18 March 1988 Received: 25 March 1988	From: Chief Geotechnical Branch Albuquerque District

Identification:

BOREHOLE 9.

Dates: 14 June 1988

REMARKS:

SEE ATTACHED PAGES.

Report sent to: Albuquerque District	Copy furnished:

Date:	Name and title: WILLIAM R. TANNER Director SWD Laboratory	Signature William R. Tanner

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : CND9
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
3.0	3.0				Bottom of overburden.
5.0	5.5	80	0.1250	Open	Fracture on one side of hole only.
14.0	15.3	180	0.2500	Open	Appears open, may be broken by drilling action.
18.4	19.0	0	0.0625	Open	Opens into cavity below.
19.0	19.0				Top of cavity. Goes beyond camera range.
20.0	20.0				Bottom of cavity.
22.7	22.9	90	0.0625	Healed	Light mineral filling.
23.3	23.3	0	0.0625	Open	
23.8	24.7	0	0.0625	Open	Appears broken by drilling action.
24.7	26.3	270	0.2500	Open	Appears broken by drilling action.
26.3	27.1	270	0.2500	Open	
27.1	27.6	10	4.0000	Open	Fracture very wide. Bottom goes beyond limits of camera lights.
34.2	34.5	40	0.0413	Healed	Light mineral filling.
35.3	36.1	180	0.2500	Open	Filled with light mineral.
37.3	38.5	270	0.7500	Open	Partly filled with lt min.
39.5	39.5	0	2.0000	Open	Broken zone about 2 inches deep.
40.7	41.9	270	0.0050	Closed	Partly filled with lt min.
43.6	43.9	45	0.0050	Healed	Light mineral filling.
43.9	44.0	45	0.0050	Healed	Light mineral filling.
44.6	45.1	45	0.0050	Tight	
45.6	45.7	70	0.0050	Tight	
46.0	46.3	15	0.0625	Tight	
46.7	46.9	0	0.0050	Open	
46.8	47.1	0	0.0050	Tight	
50.6	50.9	80	3.0000	Open	
53.3	53.5	135	0.0625	Open	
56.6	56.7	135	0.0625	Open	Partially filled with lt. mineral, fracture is irregular.
56.6	56.8	135	0.0625	Open	Fracture is vuggy. Partially open.
58.0	58.3	60	0.0050	Healed	Light mineral filling.
58.7	58.7	0	0.0625	Open	Horizontal.
58.7	59.1	0	0.0625	Open	Merges with above fracture.
59.4	59.8	135	0.0625	Open	

BOREHOLE ANALYSIS
Input Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : CND9
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
59.8	60.2	135	0.0625	Open	Same as above.
61.1	61.2	225	0.1250	Healed	Light mineral filling.
62.9	62.9				Top of broken zone.
63.2	63.2				Bottom of broken zone.
70.2	70.3	45	0.0625	Open	
73.6	74.3	180	0.2500	Open	
74.4	75.0	315	0.0625	Open	Irregular dip.
75.1	75.4	180	0.6250	Open	Partly filled with lt min.
76.0	76.1	45	0.2500	Open	Rock broken along fracture plane.
76.2	76.2				Top of broken zone.
76.8	76.8				Bottom of broken zone.
79.3	79.8	315	0.0312	Open	
80.4	80.9	45	0.5000	Open	
83.0	83.3	45	0.5000	Open	
83.4	83.4				Fracture zone: numerous hairline fractures with random strike and dip. Irregular and open.
87.6	87.6				Bottom of above zone.
87.6	87.9	30	2.0000	Open	Filled with broken material.
91.7	92.1	315	1.5000	Open	Filled with broken material.
92.3	92.7	60	0.0625	Open	
93.3	93.5	300	0.0625	Open	
100.0	100.9	315	0.0050	Open	Partially open and healed. Vertical. Fracture enters and exits from same side of hole.
101.3	101.4	90	0.0050	Open	Partially open and healed.
102.1	102.4	315	0.1250	Open	Discontinuous.
105.0	105.0				End of videotaping.

BOREHOLE ANALYSIS
Output Data

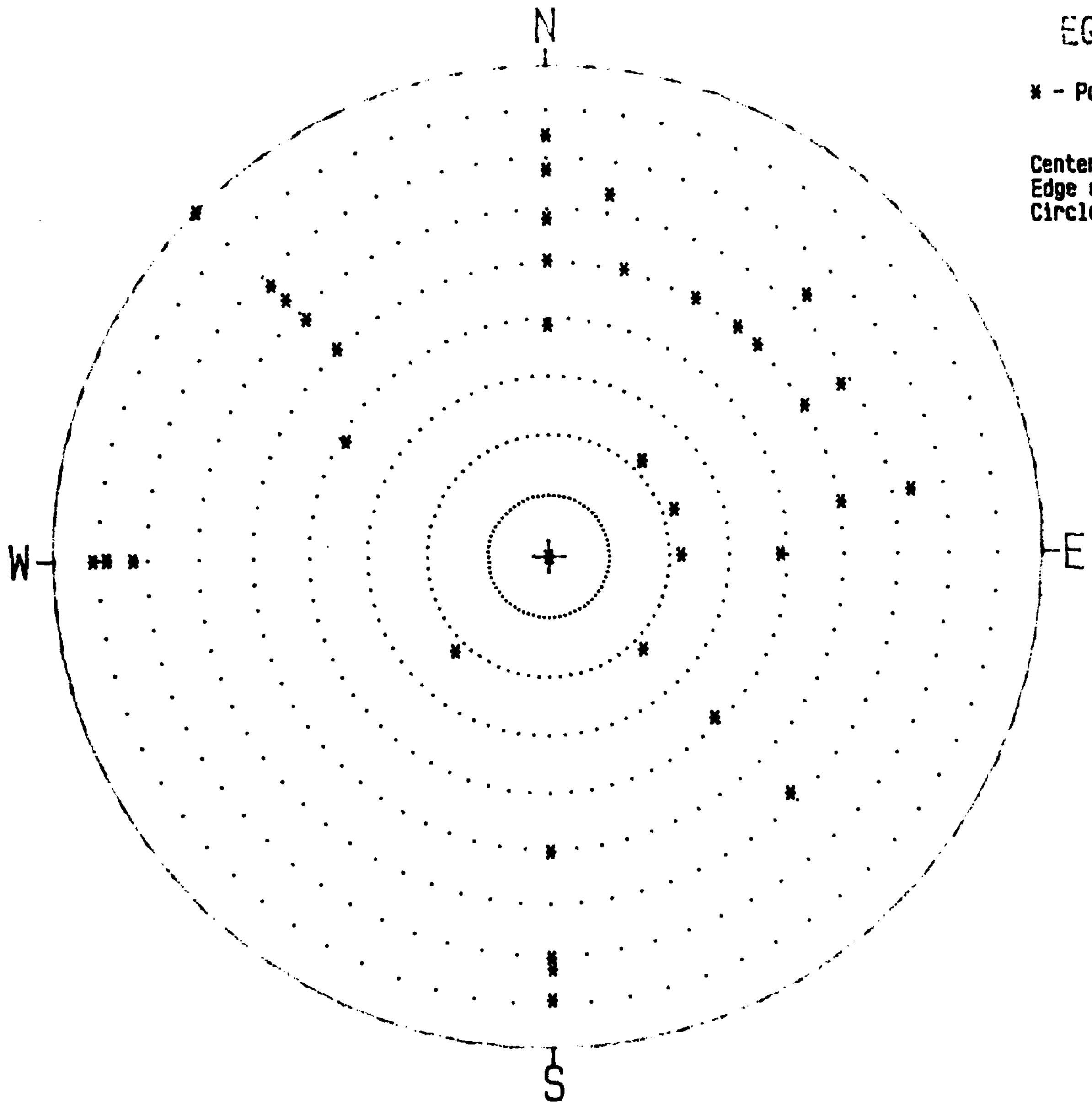
Project Name : Cuchillo Negro Dam
Drill Hole Name : CND9
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
3.0					Bottom of overburden.
5.3	80	64	0.0556	Open	Fracture on one side of hole only.
14.6	180	79	0.0469	Open	Appears open, may be broken by drilling action.
18.7	0	68	0.0239	Open	Opens into cavity below.
19.0					Top of cavity. Goes beyond camera range.
20.0					Bottom of cavity.
22.8	90	39	0.0487	Healed	Light mineral filling.
23.3	0	0	0.0625	Open	
24.3	0	75	0.0166	Open	Appears broken by drilling action.
25.5	270	81	0.0383	Open	Appears broken by drilling action.
26.7	270	73	0.0741	Open	
27.4	10	64	1.7793	Open	Fracture very wide. Bottom goes beyond limits of camera lights.
34.3	40	50	0.0263	Healed	Light mineral filling.
35.7	180	73	0.0741	Open	Filled with light mineral.
37.9	270	78	0.1520	Open	Partly filled with lt min.
39.5	0	0	2.0000	Open	Broken zone about 2 inches deep.
41.3	270	78	0.0010	Closed	Partly filled with lt min.
43.8	45	50	0.0032	Healed	Light mineral filling.
44.0	45	22	0.0046	Healed	Light mineral filling.
44.8	45	64	0.0022	Tight	
45.7	70	22	0.0046	Tight	
46.2	15	50	0.0399	Tight	
46.8	0	39	0.0039	Open	
47.0	0	50	0.0032	Tight	
50.8	80	50	1.9130	Open	
53.4	135	39	0.0487	Open	
56.7	135	22	0.0580	Open	Partially filled with lt. mineral, fracture is irregular.
56.7	135	39	0.0487	Open	Fracture is vuggy. Partially open.
58.2	60	50	0.0032	Healed	Light mineral filling.
58.7	0	0	0.0625	Open	Horizontal.
58.9	0	58	0.0330	Open	Merges with above fracture.
59.6	135	58	0.0330	Open	

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Negro Dam
Drill Hole Name : CND9
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
60.0	135	58	0.0330	Open	Same as above.
61.2	225	22	0.1160	Healed	Light mineral filling.
62.9					Top of broken zone.
63.2					Bottom of broken zone.
70.3	45	22	0.0580	Open	
73.9	180	70	0.0836	Open	
74.7	315	68	0.0239	Open	Irregular dip.
75.3	180	50	0.3985	Open	Partly filled with lt min.
76.1	45	22	0.2319	Open	Rock broken along fracture plane.
76.2					Top of broken zone.
76.8					Bottom of broken zone.
79.6	315	64	0.0139	Open	
80.7	45	64	0.2224	Open	
83.2	45	50	0.3188	Open	
83.4					Fracture zone: numerous hairline fractures with random strike and dip. Irregular and open.
87.6					Bottom of above zone.
87.8	30	50	1.2753	Open	Filled with broken material.
91.9	315	58	0.7912	Open	Filled with broken material.
92.5	60	58	0.0330	Open	
93.4	300	39	0.0487	Open	
100.4	315	90	0.0013	Open	Partially open and healed. Vertical. Fracture enters and exits from same side of hole.
101.3	90	22	0.0046	Open	Partially open and healed.
102.3	315	50	0.0797	Open	Discontinuous.
105.0					End of videotaping.



EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name :Cuchillo Negro Dam

Drill Hole :CND9 Hole Size : NX
Orientation :Vertical
Direction :0 Hade : 0
Photographed and Interpreted by the
Southwest Division Lab

DEPARTMENT OF THE ARMY
WALLA WALLA DISTRICT, CORPS OF ENGINEERS
BUILDING 602, CITY-COUNTY AIRPORT
WALLA WALLA, WASHINGTON 99362

REPLY TO
ATTENTION OF:

CENPWEN-GB (1110-2-1906a) 25 March 1988

MEMORANDUM FOR: Commander, U.S. Army Corps of Engineers, Albuquerque District, ATTN: CESPK-G (Mr. Jim MacAdoo), Post Office Box 1580, Albuquerque, New Mexico 87103-1580

SUBJECT: Results of Borehole Photography, Cuchillo Damsite

1. Enclosed are the results of borehole photography performed on three drill holes located at the Cuchillo Damsite.

2. Results of interpretation include fracture orientation and equal area polar plots of joints for each drill hole. A composite plot representing all drill holes is also included.

3. Included with the report are the video tapes of the borehole photography. This completes the requested work on this project.

4. If you have any questions or need future assistance, please call Mr. John Roadifer, telephone No. 509-522-6776.

FOR THE COMMANDER:

Encl

MARVIN G. BRAMMER, P.E.
Chief, Engineering Division

Cuchillo Damsite, New Mexico
Borehole Photography

Prepared for

Albuquerque District
U.S. Army Corps of Engineers

By
Walla Walla District
U.S. Army Corps of Engineers

March 1988

CUCHILLO DAMSITE, NEW MEXICO
BOREHOLE PHOTOGRAPHY

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APPENDIXES

A.	Borehole Photography Plots for Drill Holes	

CUCHILLO DAMSITE, NEW MEXICO
BOREHOLE PHOTOGRAPHY

I. PURPOSE AND AUTHORIZATION

A. Purpose.

The purpose of this study was to determine the orientations and aperatures of the joints and fractures at the proposed Cuchillo Damsite. The results of the borehole photography are to be used to aid in the design of the proposed dam.

B. Authorization.

The borehole photography work was authorized by the Albuquerque District, U.S. Army Corps of Engineers.

II. SITE DESCRIPTION

Cuchillo damsite is located approximately 130 miles south southwest of Albuquerque,New Mexico. The general geology of the site is carbonate rocks that dip in a north-easterly direction at 20 to 30 degrees. A plan view of the site is shown in Plate 1. The names of the drill holes used for the photography appear under the actual drill hole designations in parenthesis.

III. BOREHOLE PHOTOGRAPHY

The borehole photography was performed during the week of 28 September 1988. Photography of six drill holes was attempted with three of those drill holes being successfully photographed. The photography was accomplished in all of the drill holes by using the high resolution video camera for direct downhole views of the walls and oriented video logs were obtained with the video camera in combination with a conical mirror and compass. No water was encountered in any of the drill holes. The following are the drill holes that were photographed:

Drill Hole	Attitude	Direction	# Degrees from Vertical
CN-CH-1	Vertical	-	-
CN-CH-9	Vertical	-	-
CN-CH-11	Vertical	-	-

IV. EVALUATION

The video logs were analyzed and the results of the interpretation are shown in Appendix A. Each drill hole is represented by the following:

- table of output data
- equal area polar plot showing joint poles and bedding

features
- contour plot of percent poles per 1% area
- fracture frequency plots of all fractures and open fractures
- aperture distribution plot

Following the drill hole results there are a group of plots representing the composite of all of the drill holes. These plots include the following:

- equal area polar plot of all joint poles
- equal area polar plot of the poles of only the open fractures
- equal area polar plot of the bedding features
- equal area polar plot of the percent of joint poles present in each 1% counting circle used.

The plots indicate that there are two joint sets at the site. The orientations of the two joint sets are:

	Dip Direction	Dip
Set 1	270 +- 25 degrees	70 +- 10 degrees
Set 2	60 +- 30 degrees	25 +- 15 degrees

Joint set 2 is the same as the bedding direction and therefore it is possible that a number of the joints that lie in that set are actually bedding features that have been interpreted as joints. The outcrops at the project site appear to display two very steep nearly perpendicular joint sets that are themselves nearly perpendicular to the bedding orientation. The results of the photography do not clearly reflect this. There are a scattering of steep joints present throughout the three holes that could be part of the second steep joint set. These joints all have orientations that are generally dipping to the south at about 70 degrees. Since the holes are all vertical it is possible that not enough joints were intersected to effectively show this joint set.

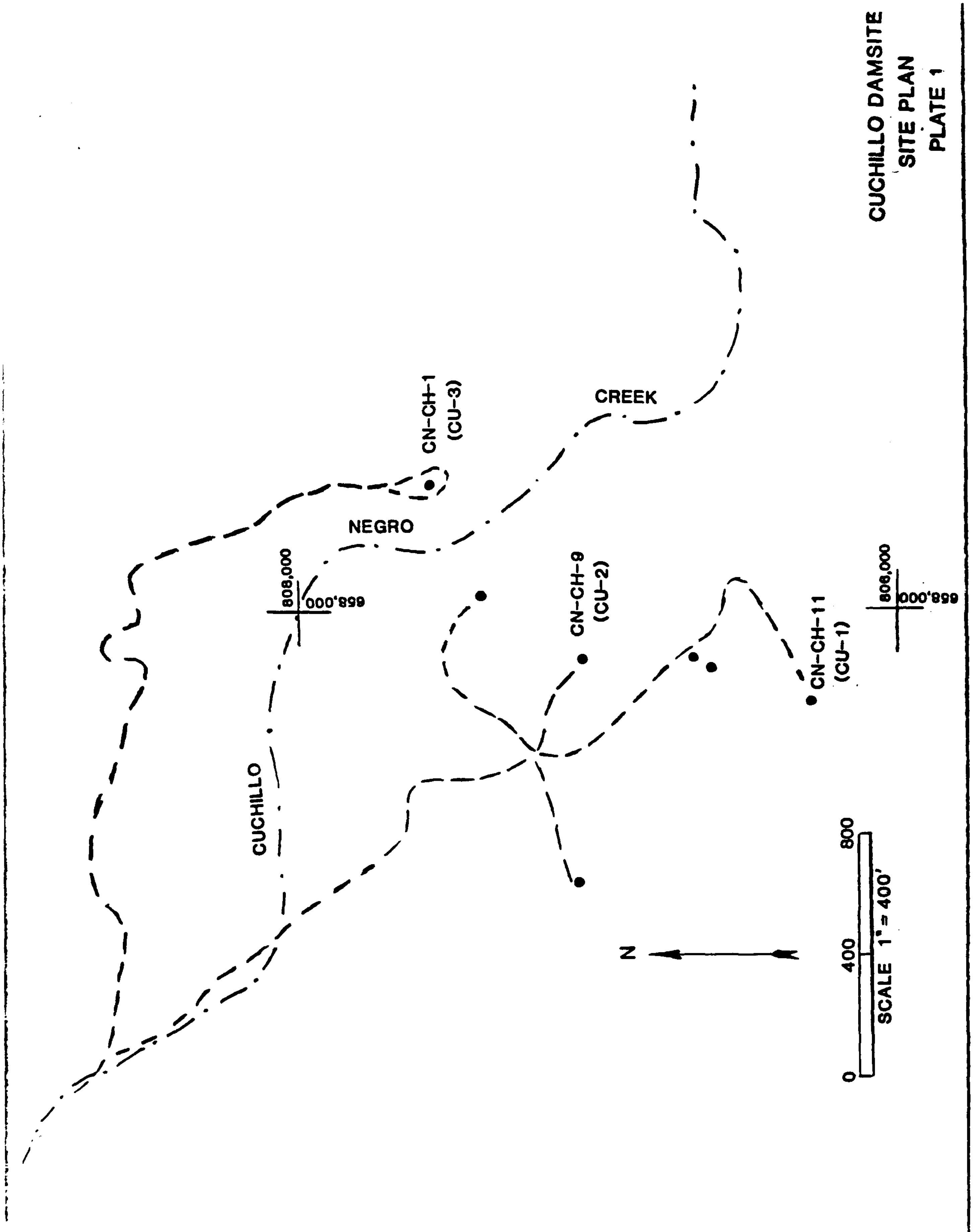
The fracture frequency and aperture distribution plots should be used as information only type data. The fracture frequency plot can be utilized to see what the fracture spacing in the ground looks like and the aperture plot provides some information on the tightness of the rock to groundwater movement through open fractures. As can be seen on the fracture frequency plots for the open fractures the rock at the Cuchillo Damsite is generally widely spaced and in the ground RQD measurements would be very close to 100%. The aperture distribution plots indicate that the rock is very tight with most of the fractures having openings of .01 to .03 inches. This combined by the relatively wide spacing of the open fractures should combine to produce low hydraulic conductivity values. It is important to remember that the fracture frequency plots are only indicative of the vertical direction and that the fracture spacing could be much closer in a direction normal to the orientation of the joint sets.

V. CONCLUSIONS

The borehole photography of the three holes clearly reflects two joints and shows some indications of a third set with the following orientations:

	Dip Direction	Dip
Set 1	270 +- 25 degrees	70 +- 10 degrees
Set 2	60 +- 30 degrees	25 +- 15 degrees
Set 3	180 +- 40 degrees	70 +- 20 degrees

The borehole photography would have provided much better results with particular regards to the third joint set if there had been some angled drill holes present at the site. Vertical drill holes tend to not intersect enough fractures or joints in near vertical sets to clearly define them.


CUCHILLO DAMSITE
SITE PLAN
PLATE 1
CN-CH-1
(CU-3)
CREEK
NEGRO
808,000
668,000
CN-CH-9
(CU-2)
CN-CH-11
(CU-1)
808,000
668,000
CUCHILLO
N
0
400
800
SCALE 1" = 400'

APPENDIX A

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
						Photography begins at 120.5 feet
						No water present in drill hole
1	120.61	266.00	78.87	0.0232	Healed	Light mineral filling.
1	119.62	296.00	60.44	0.0296	Healed	Light mineral filling.
1	118.28	76.00	31.60	0.0307	Healed	Light mineral filling.
1	118.20	61.00	40.73	0.0455	Open	
1	117.62	96.00	31.60	0.0102	Healed	Light mineral filling.
1	117.43	61.00	7.01	0.0357	Healed	Light mineral filling.
						Several small healed fractures.
1	117.07	266.00	61.00	0.0029	Healed	Light mineral filling.
1	116.52	88.00	26.20	0.0108	Healed	Light mineral filling.
						2 parallel fractures.
1	115.52	281.00	56.61	0.0264	Healed	Light mineral filling.
1	109.65	271.00	82.45	0.0236	Open	
1	106.08	83.00	29.86	0.0416	Healed	Light mineral filling.
						Maybe a bedding feature.
1	105.56	336.00	69.72	0.0083	Healed	Light mineral filling.
1	105.41	256.00	64.00	0.5786	Open	Partly filled with lt min.
1	103.70	116.00	26.20	0.0108	Open	Partly filled with lt min.
1	102.61	43.00	31.60	0.0102	Healed	Light mineral filling.
1	100.98	201.00	64.00	0.0158	Open	Partly filled with lt min.
1	100.12	91.00	22.30	0.0555	Open	Partly filled with lt min.
1	99.37	58.00	40.73	0.0273	Open	Mostly filled with lt min.
1	99.23	356.00	90.00	0.0331	Healed	Vertical fracture.
1	98.40	221.00	44.54	0.0086	Healed	Light mineral filling.
1	98.29	51.00	31.60	0.0204	Healed	Light mineral filling.
1	97.18	56.00	22.30	0.0555	Open	Mostly filled with lt min.
1	95.81	71.00	31.60	0.0204	Open	Mostly filled with lt min.
1	93.10	111.00	37.92	0.0947	Open	Mostly filled with lt min.
1	92.38	46.00	34.88	0.1477	Open	Maybe a bedding feature
1	91.38	191.00	51.81	0.2226	Open	Partly filled with lt min.
6	90.97	46.00	39.36	1.1134	N/A	Bedding feature
1	90.74	241.00	50.89	0.0038	Healed	Light mineral filling.
1	89.09	281.00	62.07	0.0056	Healed	Light mineral filling.
1	86.43	61.00	24.28	0.0109	Open	Partly filled with lt min.
1	84.80	16.00	24.28	0.0219	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	84.82	236.00	59.86	0.0030	Healed	Light mineral filling.
1	84.46	31.00	36.43	0.0193	Open	Mostly filled with lt min.
1	84.12	76.00	52.69	0.0182	Healed	Light mineral filling.
1	83.73	231.00	49.94	0.0077	Healed	Light mineral filling.
1	83.30	246.00	24.28	0.0219	Open	Partly filled with lt min.
1	82.19	56.00	39.36	0.9279	Open	Maybe a bedding feature.
1	78.51	161.00	64.44	0.0518	Open	Partly filled with lt min.
1	74.93	38.00	31.60	0.0204	Healed	Light mineral filling.
1	73.93	26.00	70.27	0.0405	Open	Fracture splits
1	73.03	206.00	68.21	0.2227	Open	
1	70.60	346.00	20.26	0.0023	Healed	Light mineral filling.
1	68.37	271.00	51.81	0.0074	Healed	Light mineral filling. Bottom of fracture is estimated
1	66.25	263.00	77.50	0.0013	Healed	Light mineral filling.
1	65.53	321.00	29.86	0.0520	Healed	Light mineral filling.
1	62.74	41.00	40.73	0.1819	Healed	Light mineral filling.
1	61.23	76.00	34.88	0.0984	Healed	Light mineral filling.
1	60.26	36.00	26.20	0.0323	Open	Partly filled with lt min.
1	59.93	78.00	36.43	0.0483	Healed	Light mineral filling.
1	59.34	51.00	37.92	0.0284	Open	Partly filled with lt min. Rock appears broken
1	58.10	361.00	55.13	0.1715	Open	
1	57.31	56.00	45.71	0.0168	Healed	Light mineral filling.
1	55.47	46.00	9.32	0.1184	Healed	Light mineral filling.
1	55.16	231.00	36.43	0.0483	Healed	Light mineral filling.
1	55.23	176.00	66.09	0.0195	Healed	Light mineral filling.
1	54.90	61.00	13.82	0.0233	Healed	Light mineral filling.
1	54.61	156.00	16.02	0.0577	Healed	Light mineral filling.
1	53.32	81.00	52.69	0.0073	Healed	Light mineral filling.
1	51.70	31.00	37.92	0.0189	Open	Partly filled with lt min. 2 parallel fractures
1	49.07	71.00	55.13	0.0549	Open	
1	48.15	81.00	33.27	0.0502	Open	Mostly filled with lt min. Numerous small healed fractures
1	47.65	46.00	28.06	0.0318	Healed	Light mineral filling.
1	47.57	106.00	31.60	0.0409	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

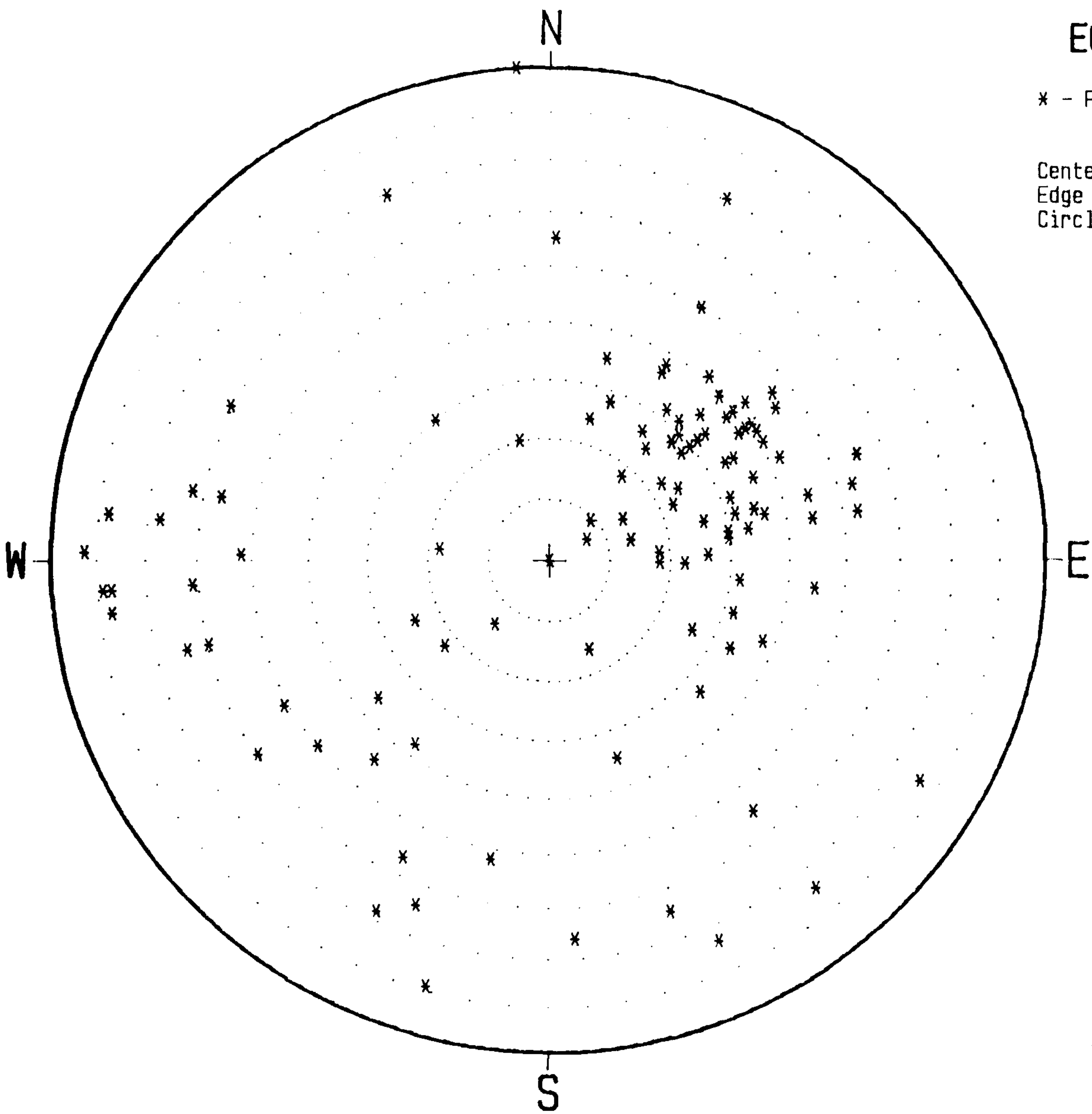
Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	47.29	206.00	56.61	0.0013	Healed	Light mineral filling.
1	46.99	41.00	18.16	0.0114	Healed	Light mineral filling.
1	46.55	76.00	44.54	0.0171	Open	Partly filled with lt min.
1	46.54	276.00	18.16	0.0171	Healed	Light mineral filling.
1	46.32	81.00	44.54	0.0086	Healed	Light mineral filling.
1	46.17	221.00	13.82	0.1165	Healed	Light mineral filling.
1	46.16	76.00	34.88	0.0098	Healed	Light mineral filling.
1	45.79	141.00	55.13	0.1372	Open	Mostly filled with lt min.
1	45.49	56.00	37.92	0.0142	Healed	Light mineral filling.
1	45.25	71.00	55.13	0.0137	Healed	Light mineral filling.
1	44.97	61.00	33.27	0.0201	Healed	Light mineral filling.
1	44.33	68.00	36.43	0.0965	Open	Partly filled with lt min.
1	44.40	141.00	74.34	0.0648	Open	Partly filled with lt min.
1	43.89	256.00	59.86	0.0060	Healed	Light mineral filling.
1	43.25	61.00	34.88	0.0246	Healed	Light mineral filling.
1	43.01	81.00	29.86	0.0104	Healed	Light mineral filling.
1	42.51	46.00	29.86	0.1041	Healed	Light mineral filling.
1	42.29	231.00	22.30	0.0056	Healed	Light mineral filling.
1	41.66	51.00	31.60	0.0204	Healed	Light mineral filling.
1	41.41	131.00	33.27	0.0100	Healed	Light mineral filling.
1	40.97	51.00	42.06	0.0045	Healed	Light mineral filling.
1	40.28	51.00	28.06	0.0318	Healed	Light mineral filling.
1	40.67	266.00	77.04	0.0538	Open	Mostly filled with lt min.
1	40.08	51.00	39.36	0.0186	Healed	Light mineral filling.
1	39.64	51.00	29.86	0.0104	Healed	Light mineral filling.
6	39.15	41.00	24.28	0.0109	N/A	Dark bedding plane
1	38.43	66.00	22.30	0.0111	Healed	Light mineral filling.
1	37.65	276.00	67.54	0.1834	Open	Partly filled with lt min.
1	35.08	156.00	73.44	0.6841	Open	Partly filled with lt min.
1	33.72	53.00	46.83	0.0657	Healed	Light mineral filling.
1	33.12	51.00	33.27	0.0401	Healed	Light mineral filling.
1	29.45	11.00	0.00	0.0120	Open	
1	26.86	71.00	55.13	1.3720	Open	
1	26.27	121.00	76.16	0.086	Open	
1	26.39	161.00	34.88	0.0394	Open	
1	25.70	21.00	28.06	0.1059	Open	Partly filled with lt min.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-1
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	24.23	16.00	34.88	0.0049	Healed	Light mineral filling.
1	23.95	116.00	33.27	0.0100	Healed	Light mineral filling.
1	23.79	276.00	77.93	0.0753	Open	Mostly filled with lt min.
1	23.21	56.00	40.73	0.0091	Healed	Light mineral filling.
1	22.94	86.00	18.16	0.1140	Open	
1	22.62	46.00	28.06	0.0529	Healed	Light mineral filling.
1	22.41	66.00	42.06	0.0446	Healed	Light mineral filling.
1	21.90	76.00	26.20	0.0431	Open	Partly filled with lt min. 19.55 - 18.66 is a cavity
1	18.16	31.00	49.94	0.1545	Open	
1	14.29	196.00	79.05	0.1824	Open	
1	12.38	216.00	37.92	0.0095	Open	
1	8.52	96.00	44.54	0.0855	Healed	Light mineral filling.
1	7.81	76.00	13.82	0.0233	Healed	Light mineral filling.
1	6.82	91.00	18.16	0.0114	Open	Partly filled with lt min. Photography ends at 6.3 feet.

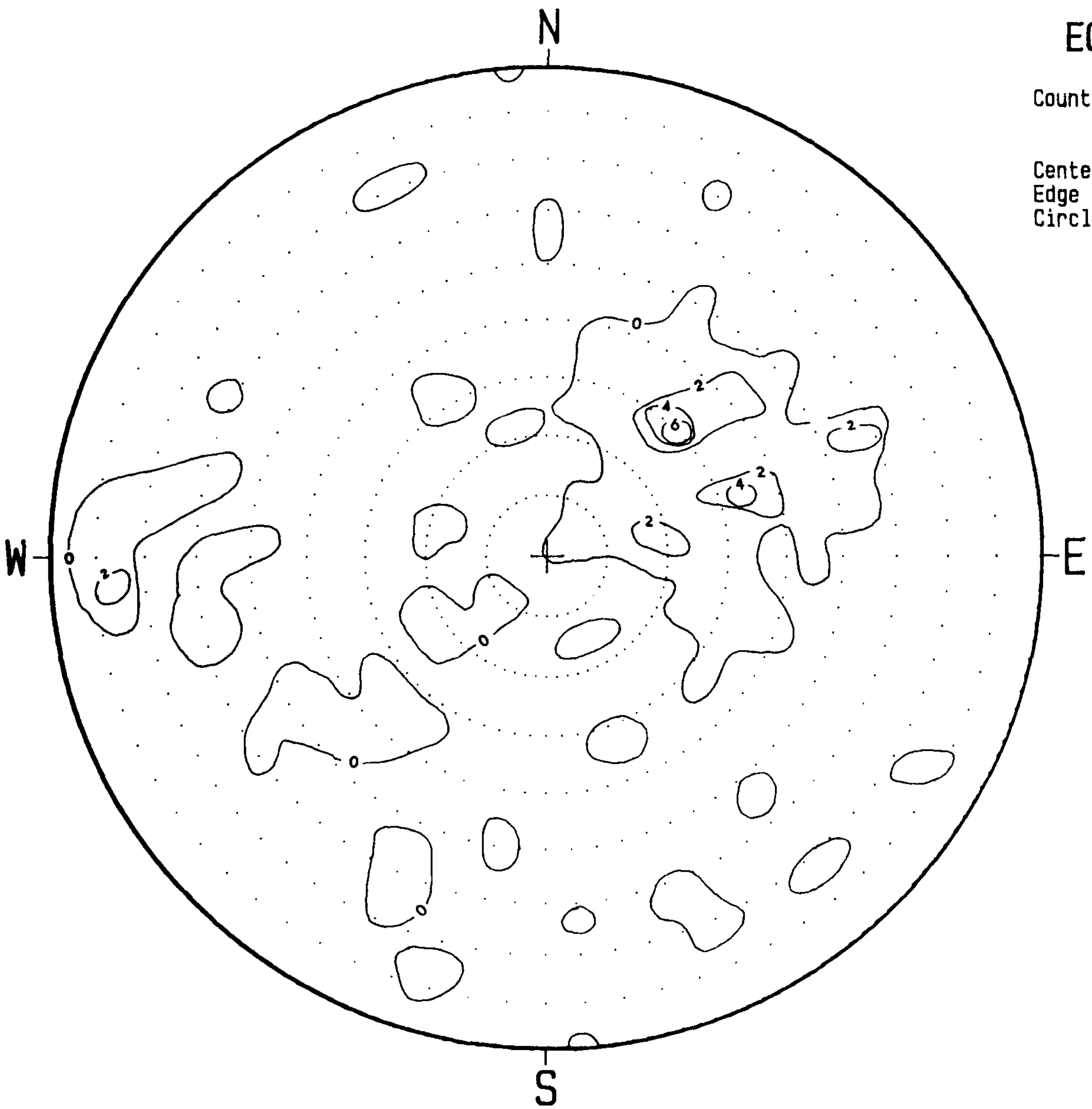


EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name: Cuchillo Damsite	
Drill Hole: CU-1	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	



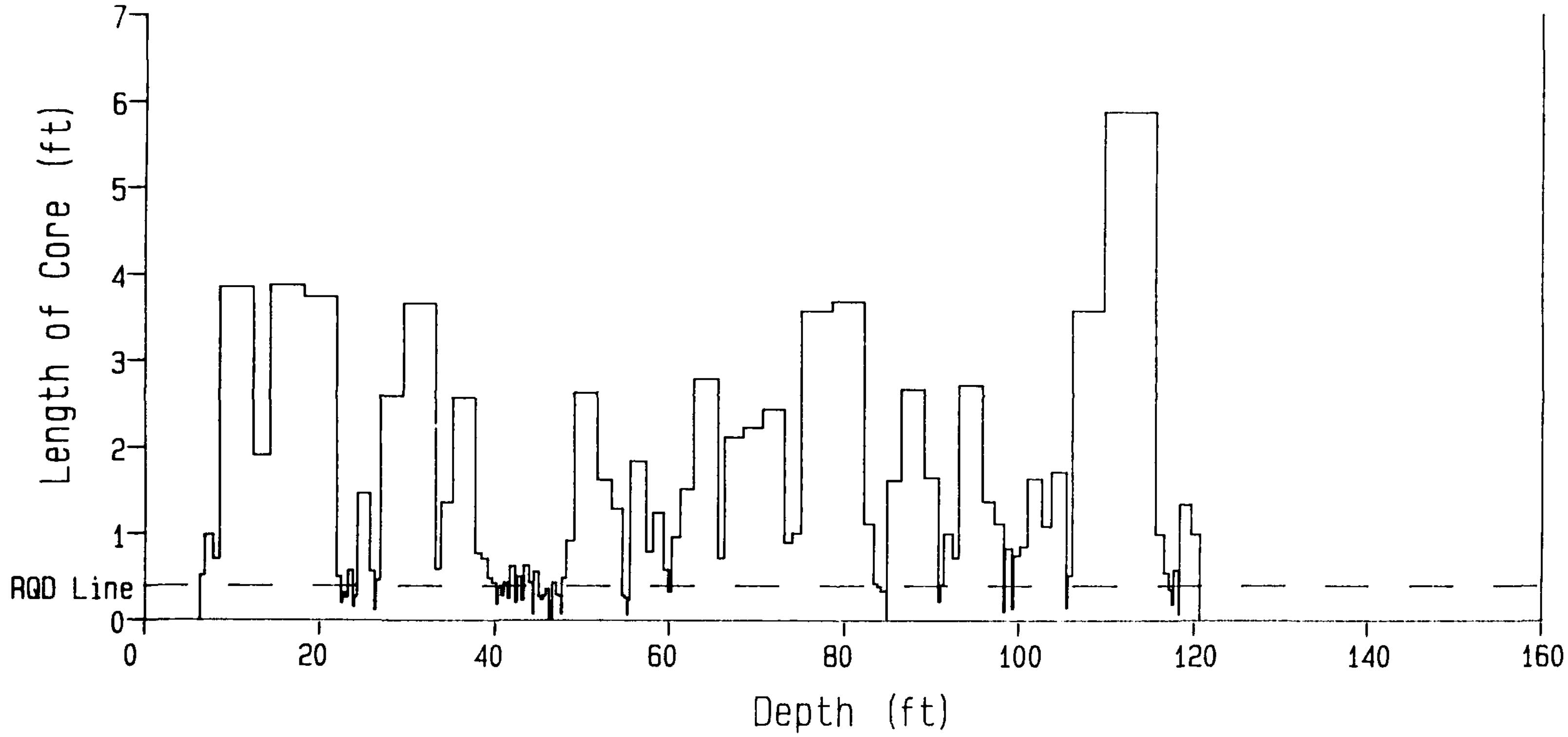
EQUAL AREA POLAR PLOT

Countours represent percent of poles per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.

Project Name: Cuchillo Damsite
Drill Hole: CU-1 Hole Size: NX Orientation: Vertical Direction: 0 Hade: 0
Photographed and Interpreted by the Walla Walla District

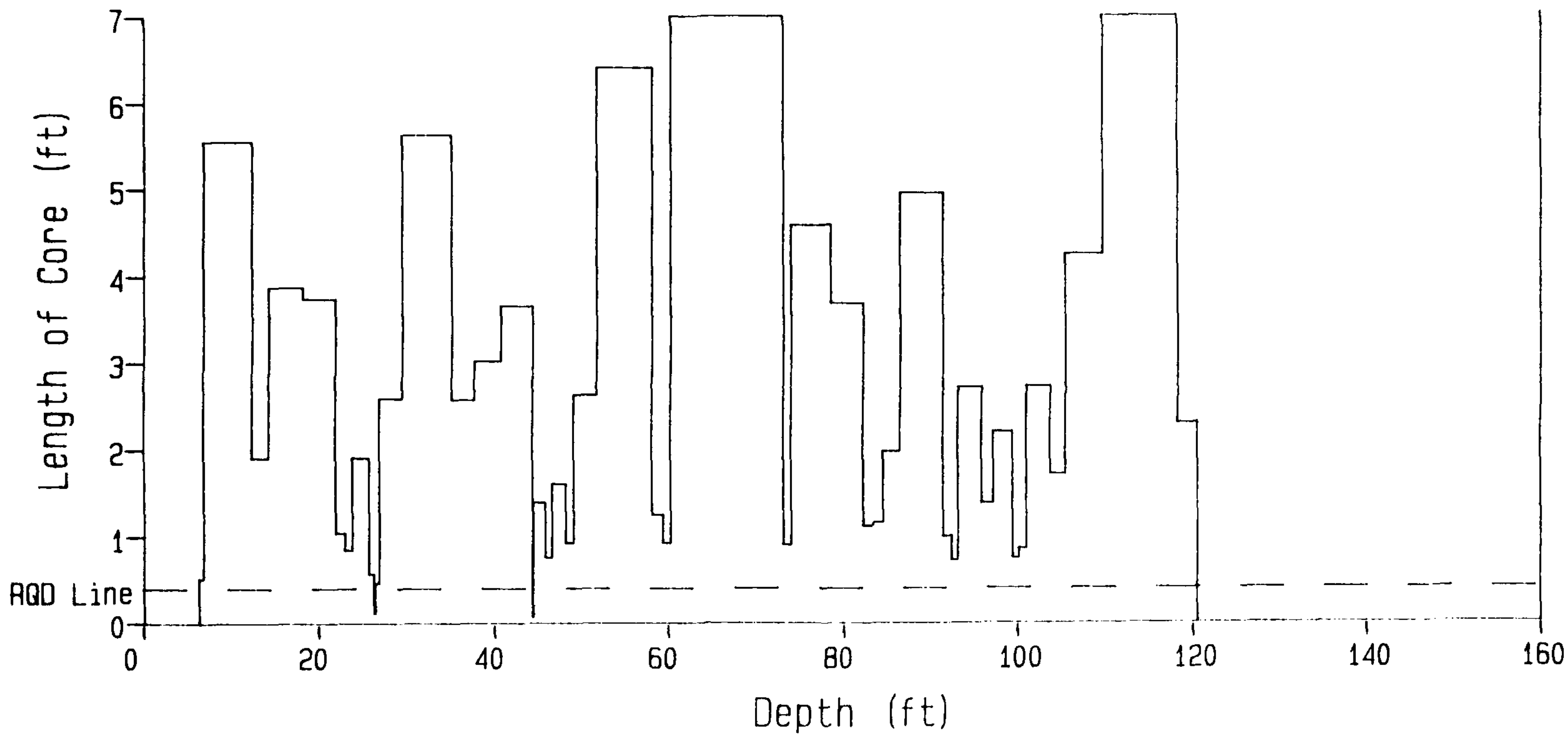
FRACTURE FREQUENCY PLOT



NOTE - All fractures

Project Name: Cuchillo Damsite
Drill Hole: CU-1 Hole Size: NX Orientation: Vertical Direction: 0 Hade: 0
Photographed and Interpreted by the Walla Walla District

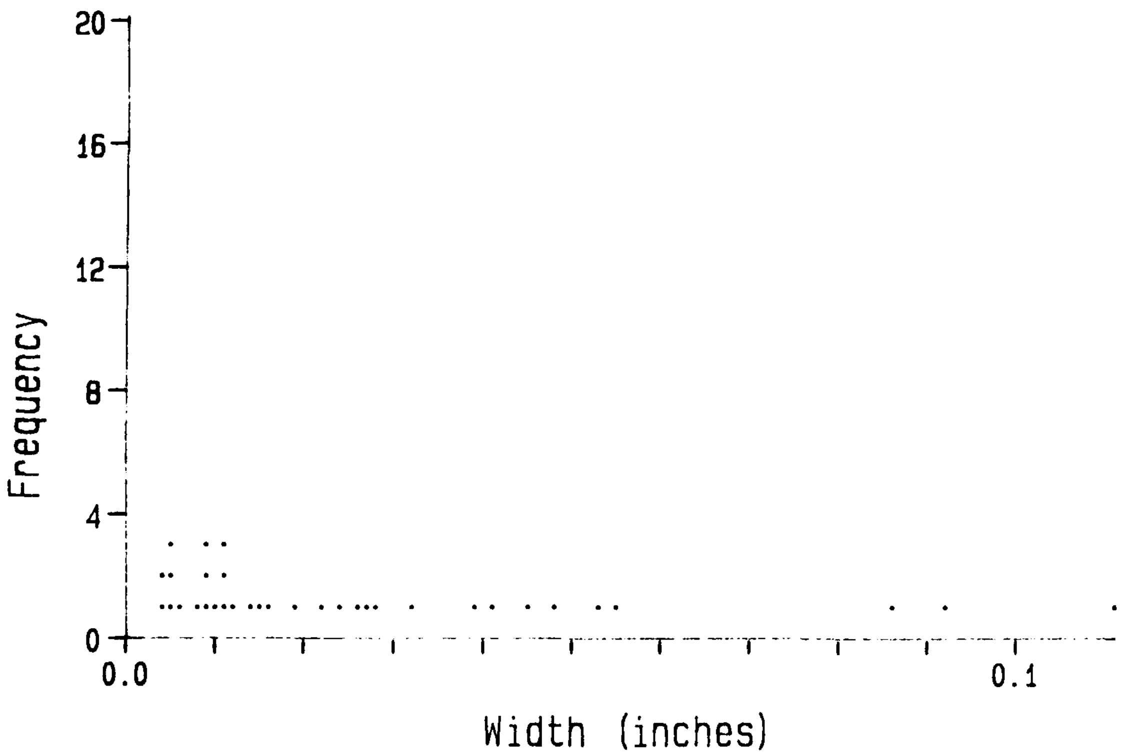
FRACTURE FREQUENCY PLOT



NOTE - Open fractures

Project Name: Cuchillo Damsite	
Drill Hole: CU-1	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	

APERATURE DISTRIBUTION



There are 10 fractures not graphed.
Largest aperature width = 1.37 inches.
Median aperature width = .026 inch.

Project Name: Cuchillo Damsite	
Drill Hole: CU-1	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
						Bottom of photography is 110.2 Rock appears broken
1	107.16	73.00	18.16	0.0114	Open	
1	106.90	271.00	76.03	0.0116	Healed	Light mineral filling.
6	105.72	66.00	18.16	0.0114	N/A	Bedding feature
1	104.28	136.00	22.30	0.0444	Healed	Light mineral filling.
1	103.83	69.00	20.26	0.0225	Healed	Light mineral filling.
1	103.50	91.00	31.60	0.0409	Open	Partly filled with lt min.
1	103.08	79.00	22.30	0.0555	Open	Partly filled with lt min.
1	102.46	86.00	24.28	0.1094	Healed	Light mineral filling.
1	102.26	46.00	24.28	0.0875	Open	
1	102.10	91.00	31.60	0.1533	Open	Direction varies
1	101.93	66.00	28.06	0.0847	Healed	Light mineral filling.
1	101.28	79.00	28.06	0.0212	Healed	Light mineral filling. 2 // fractures as above
1	100.85	73.00	24.28	0.0547	Open	Partly filled with lt min.
1	100.20	71.00	22.30	0.0222	Open	
1	99.82	81.00	20.26	0.0450	Open	Partly filled with lt min.
1	99.30	91.00	33.27	0.0201	Open	
1	99.01	336.00	24.28	0.0875	Open	Mostly filled with lt min.
1	98.91	46.00	18.16	0.0342	Open	Partly filled with lt min.
1	98.50	53.00	22.30	0.0222	Open	
1	98.15	86.00	22.30	0.0167	Open	Fracture irregular
6	97.72	79.00	24.28	0.1641	N/A	Bedding feature
1	96.74	316.00	78.79	0.0023	Healed	Light mineral filling. Generator stability problems making tape hard to interpret. Some fractures thru here but cannot interpret them.
1	93.65	68.00	24.28	0.0219	Open	
1	91.81	61.00	26.20	0.0323	Open	
1	90.88	96.00	26.20	0.1077	Healed	Light mineral filling.
1	85.44	66.00	29.86	0.0208	Healed	Light mineral filling.
6	81.37	56.00	20.26	0.0113	N/A	Bedding feature
1	80.57	58.00	28.06	0.3177	Healed	Light mineral filling.
1	79.56	146.00	70.27	0.0041	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	79.51	71.00	18.16	0.0228	Open	Partly filled with lt min.
						Numerous fine healed fractures
1	78.72	66.00	22.30	0.0111	Healed	Light mineral filling.
1	78.62	76.00	13.82	0.0583	Open	Partly filled with lt min.
1	78.11	186.00	72.21	0.0073	Healed	Light mineral filling.
6	77.71	73.00	24.28	0.0109	N/A	Bedding feature
6	76.62	76.00	33.27	0.0201	N/A	Bedding features
6	75.08	51.00	20.26	0.0113	N/A	Contact (Bedding feature)
1	73.03	56.00	16.02	0.0115	Open	
1	72.26	241.00	73.99	0.0662	Open	Vertical fracture
						71.4 - 65.0 appears broken
1	64.34	53.00	22.30	0.0111	Healed	Light mineral filling.
1	64.21	71.00	22.30	0.0111	Healed	Light mineral filling.
1	64.13	61.00	20.26	0.0225	Healed	Light mineral filling.
1	63.96	66.00	28.06	0.0053	Healed	Light mineral filling.
1	63.63	46.00	26.20	0.0108	Healed	Light mineral filling.
						4 // fractures as above
1	62.54	281.00	77.72	0.0383	Healed	Light mineral filling.
1	62.21	61.00	20.26	0.1126	Open	
1	62.06	69.00	16.02	0.0115	Healed	Light mineral filling.
1	61.73	71.00	64.44	0.0104	Open	Partly filled with lt min.
1	61.51	61.00	18.16	0.0228	Open	Partly filled with lt min.
1	61.21	63.00	24.28	0.0547	Healed	Light mineral filling.
1	58.34	233.00	73.05	0.0035	Healed	Light mineral filling.
1	58.40	66.00	33.27	0.0502	Open	Mostly filled with lt min.
1	57.91	253.00	74.84	0.0314	Healed	Light mineral filling.
1	57.17	291.00	73.99	0.0331	Healed	Light mineral filling.
6	57.12	96.00	28.06	0.2118	N/A	May be a open fracture
1	55.90	269.00	68.53	0.0044	Healed	Light mineral filling.
1	54.71	49.00	9.32	0.0118	Open	Partly filled with lt min.
1	53.80	296.00	80.45	0.0398	Open	Mostly filled with lt min.
1	53.68	96.00	33.27	0.0201	Open	
1	52.81	241.00	46.83	0.0041	Healed	Light mineral filling.
1	51.66	91.00	83.65	0.0066	Open	Vertical fracture
						Partly filled with lt min.
						Fracture splits

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

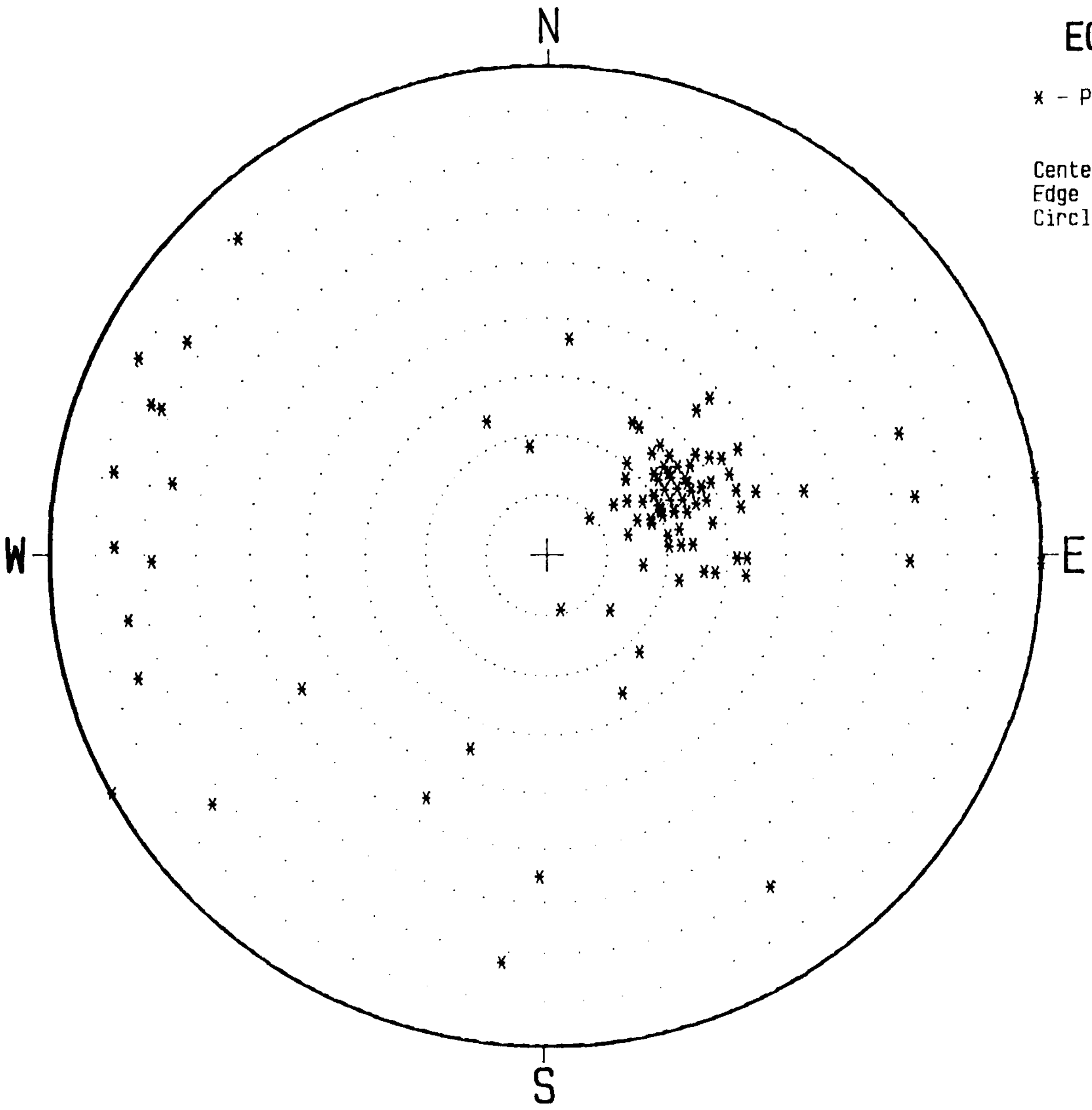
Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	51.16	151.00	26.20	0.0323	Open	Partly filled with lt min.
6	49.68	69.00	45.71	0.2514	N/A	May be an open fracture
1	48.63	101.00	22.30	0.2221	Healed	Light mineral filling.
1	47.88	56.00	29.86	0.0208	Healed	Light mineral filling.
1	47.55	291.00	71.76	0.0038	Healed	Light mineral filling.
1	47.00	71.00	26.20	0.1077	Healed	Light mineral filling.
1	46.46	46.00	18.16	0.0570	Healed	Light mineral filling.
1	45.79	66.00	26.20	0.1077	Healed	Light mineral filling.
1	45.65	53.00	24.28	0.0328	Healed	Light mineral filling.
1	45.49	61.00	22.30	0.1110	Healed	Light mineral filling.
1	44.58	59.00	31.59	0.0204	Healed	Light mineral filling.
1	43.48	46.00	37.92	0.0189	Open	Partly filled with lt min.
1	42.88	96.00	28.06	0.0106	Open	
1	42.57	86.00	20.26	0.0338	Healed	Light mineral filling. 2 // fractures as above
1	42.17	66.00	20.26	0.1126	Healed	Light mineral filling. 2 // fractures as above
1	39.09	71.00	28.06	0.0212	Healed	Light mineral filling.
1	37.05	53.00	13.82	0.2330	Healed	Light mineral filling.
1	36.62	91.00	62.58	0.0166	Healed	Light mineral filling.
1	36.49	81.00	64.44	0.0052	Healed	Light mineral filling.
1	36.51	68.00	20.26	0.0225	Healed	Light mineral filling.
1	36.16	56.00	24.28	0.0219	Healed	Light mineral filling. Some very faint healed fracs
1	35.46	351.00	18.16	0.0057	Healed	Light mineral filling.
1	34.90	366.00	36.43	0.1448	Healed	Light mineral filling.
1	34.21	61.00	36.43	0.0097	Healed	Light mineral filling.
1	32.78	281.00	65.70	0.0247	Healed	Light mineral filling. Numerous // fractures; closelv spaced
6	29.82	221.00	52.69	0.0073	N/A	Contact (Bedding feature)
1	29.61	36.00	26.20	0.1077	Open	
1	25.92	63.00	26.20	0.0215	Open	Partly filled with lt min.
1	25.44	166.00	9.32	0.0355	Healed	Light mineral filling.
1	25.30	56.00	26.20	0.0108	N/A	Bedding feature
1	23.70	56.00	22.30	0.0222	Open	Partly filled with lt min.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-2
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	22.32	261.00	74.17	0.0033	Healed	Light mineral filling.
1	20.59	71.00	22.30	0.0111	Open	
						20.1 - 18.2 appears broken
6	17.37	66.00	18.16	0.0114	N/A	Bedding feature
1	16.60	46.00	34.88	0.0197	Open	Mostly filled with lt min.
1	16.22	33.00	26.20	0.0215	Open	Partly filled with lt min.
1	15.25	96.00	16.02	0.1730	Healed	Light mineral filling.
1	14.96	206.00	45.71	0.0168	Healed	Light mineral filling.
1	14.54	76.00	44.54	0.0086	Healed	Light mineral filling.
1	14.19	41.00	20.26	0.0056	Healed	Light mineral filling.
1	13.97	201.00	34.88	0.0098	Healed	Light mineral filling.
1	13.95	131.00	13.82	0.0117	Healed	Light mineral filling.
1	13.87	71.00	20.26	0.0113	Healed	Light mineral filling.
1	13.59	181.00	55.13	0.1372	Open	Mostly filled with lt min.
6	12.82	71.00	26.20	0.0108	N/A	Bedding feature
1	12.20	61.00	33.27	0.0201	Open	
1	12.07	81.00	59.26	0.1227	Open	Vertical fracture
						Partly filled with lt min.
1	11.00	51.00	26.20	0.0215	Open	
1	10.72	58.00	24.28	0.0109	Open	
6	9.74	61.00	13.82	0.0117	N/A	Bedding feature
1	8.15	73.00	36.43	0.0097	Open	
1	7.92	76.00	33.27	0.0201	Open	
1	5.29	71.00	33.27	0.0803	Healed	Light mineral filling.
1	4.62	301.00	73.24	0.0346	Open	Partly filled with lt min.
						Photography ends at 4.0 ft

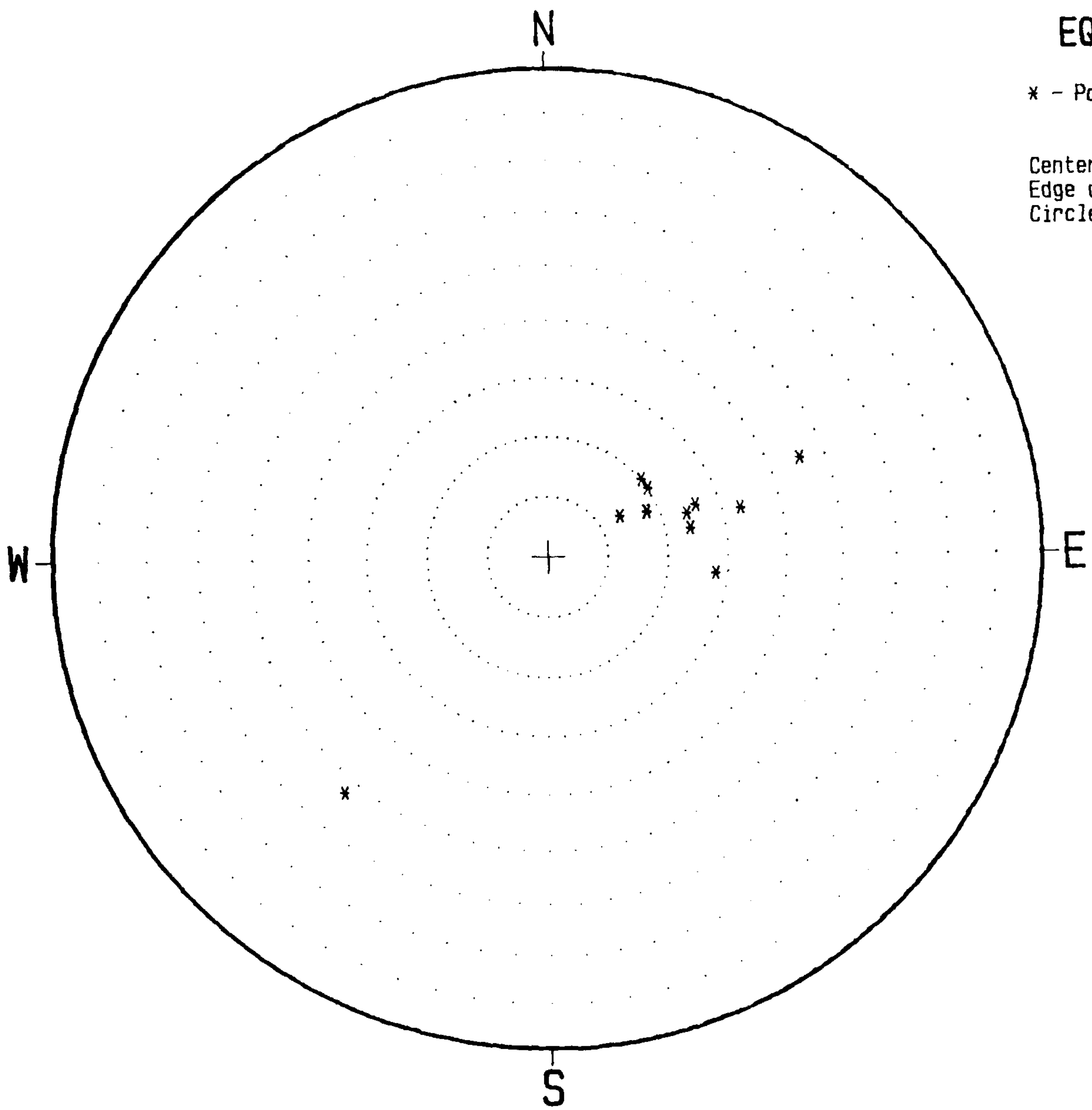
EQUAL AREA POLAR PLOT



* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name: Cuchillo Damsite	
Drill Hole: CU-2	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	



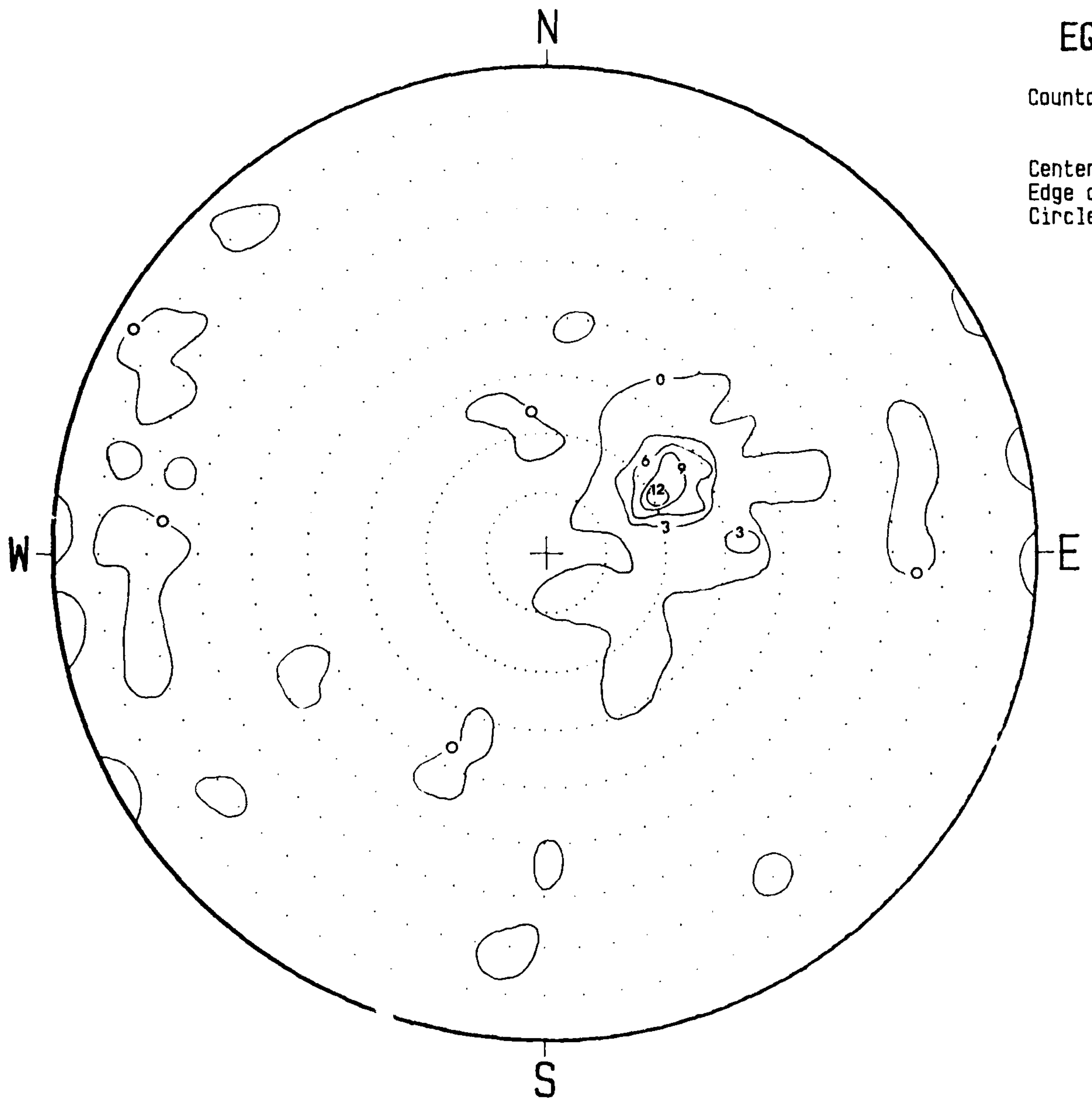
EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

NOTE - Bedding features

Project Name: Cuchillo Damsite	
Drill Hole: CU-2	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	



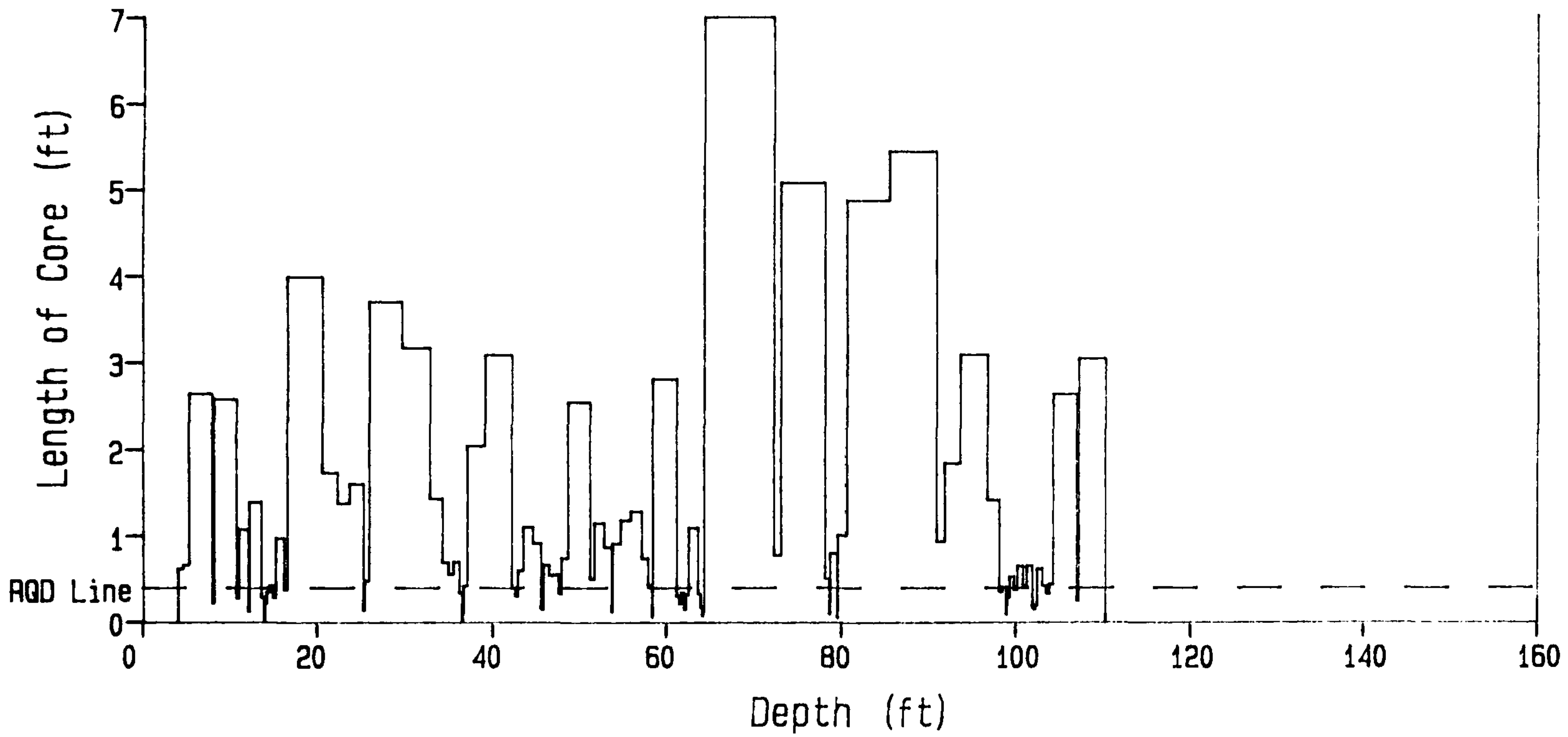
EQUAL AREA POLAR PLOT

Countours represent percent of poles per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.

Project Name: Cuchillo Damsite	
Drill Hole: CU-2	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	

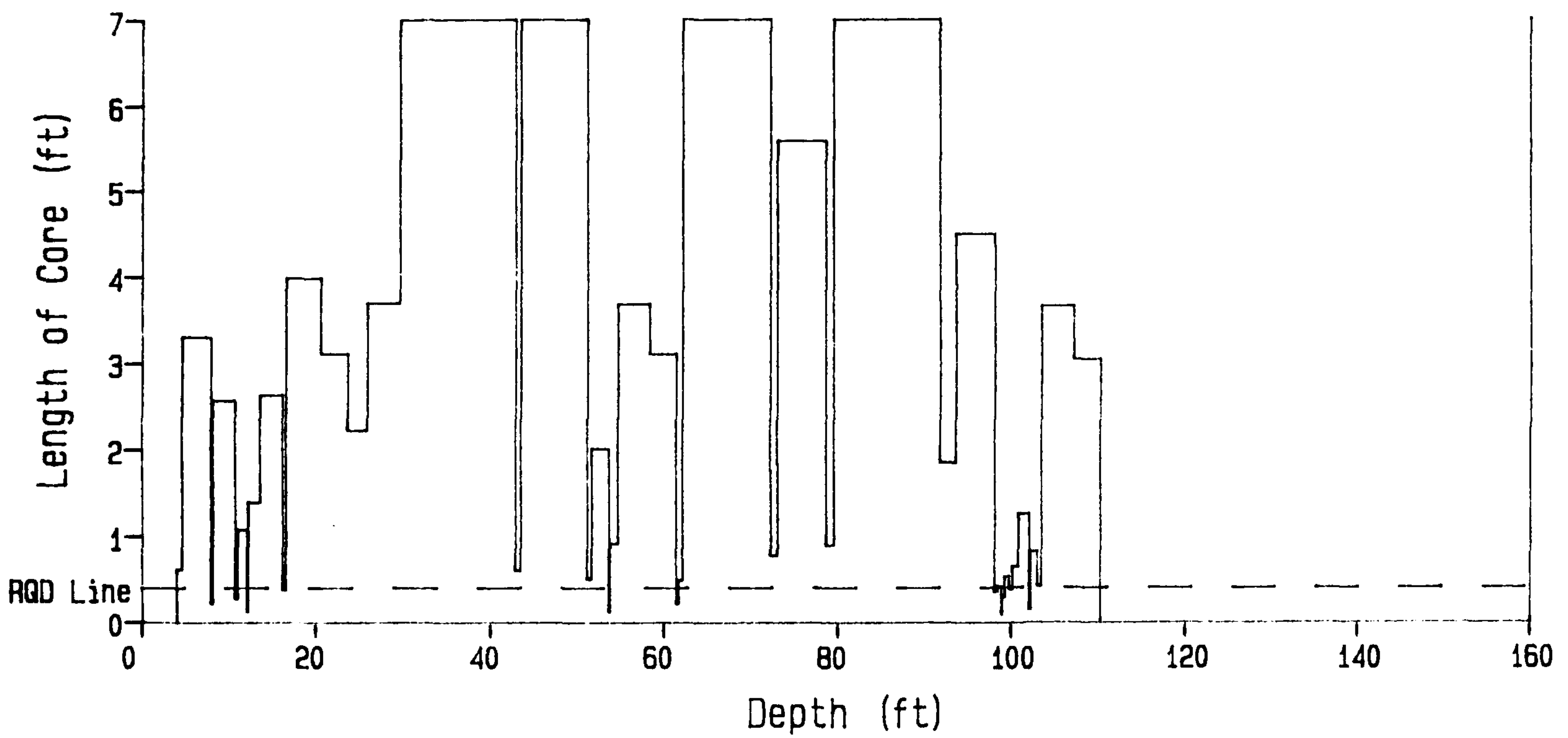
FRACTURE FREQUENCY PLOT



NOTE - All fractures

Project Name: Cuchillo Damsite
Drill Hole: CU-2 Hole Size: NX Orientation: Vertical Direction: 0 Hade: 0
Photographed and Interpreted by the Walla Walla District

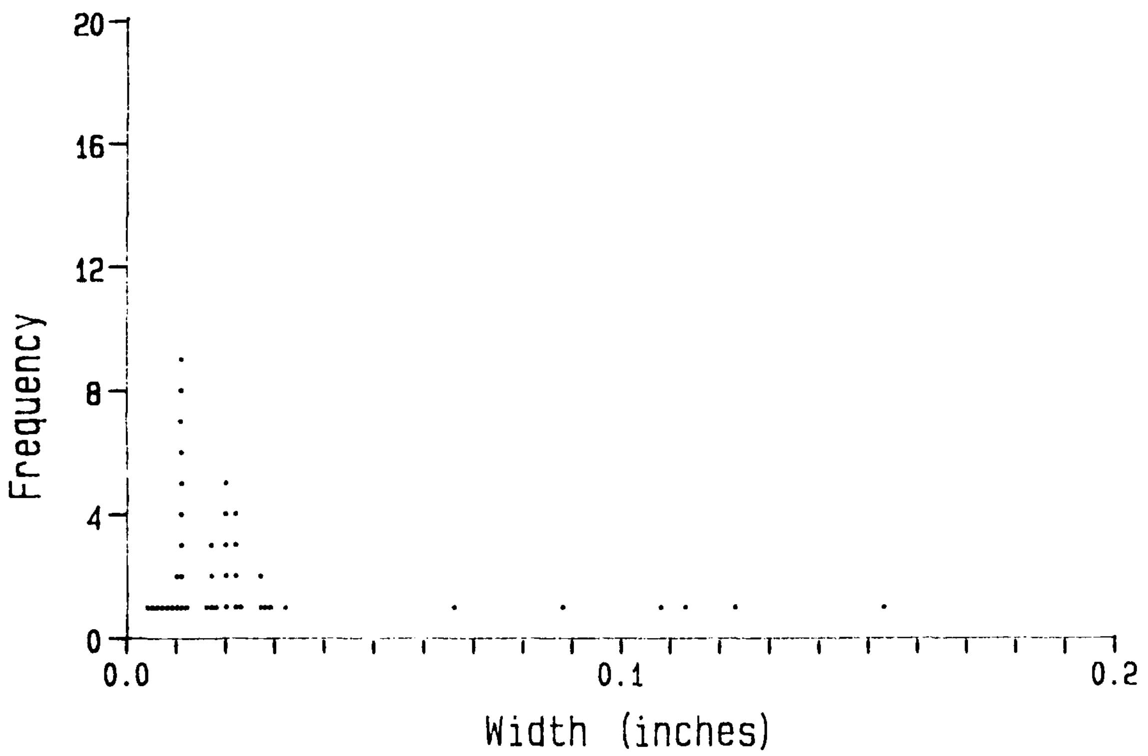
FRACTURE FREQUENCY PLOT



NOTE - Open fractures

Project Name: Cuchillo Damsite	
Drill Hole: CU-2	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	

APERATURE DISTRIBUTION



There are 0 fractures not graphed.
Largest aperature width = .15 inches.
Median aperature width = .017 inch.

Project Name: Cuchillo Damsite
Drill Hole: CU-2 Hole Size: NX Orientation: Vertical Direction: 0 Hade: 0
Photographed and Interpreted by the Walla Walla District

BOREHOLE ANALYSIS
Output Data

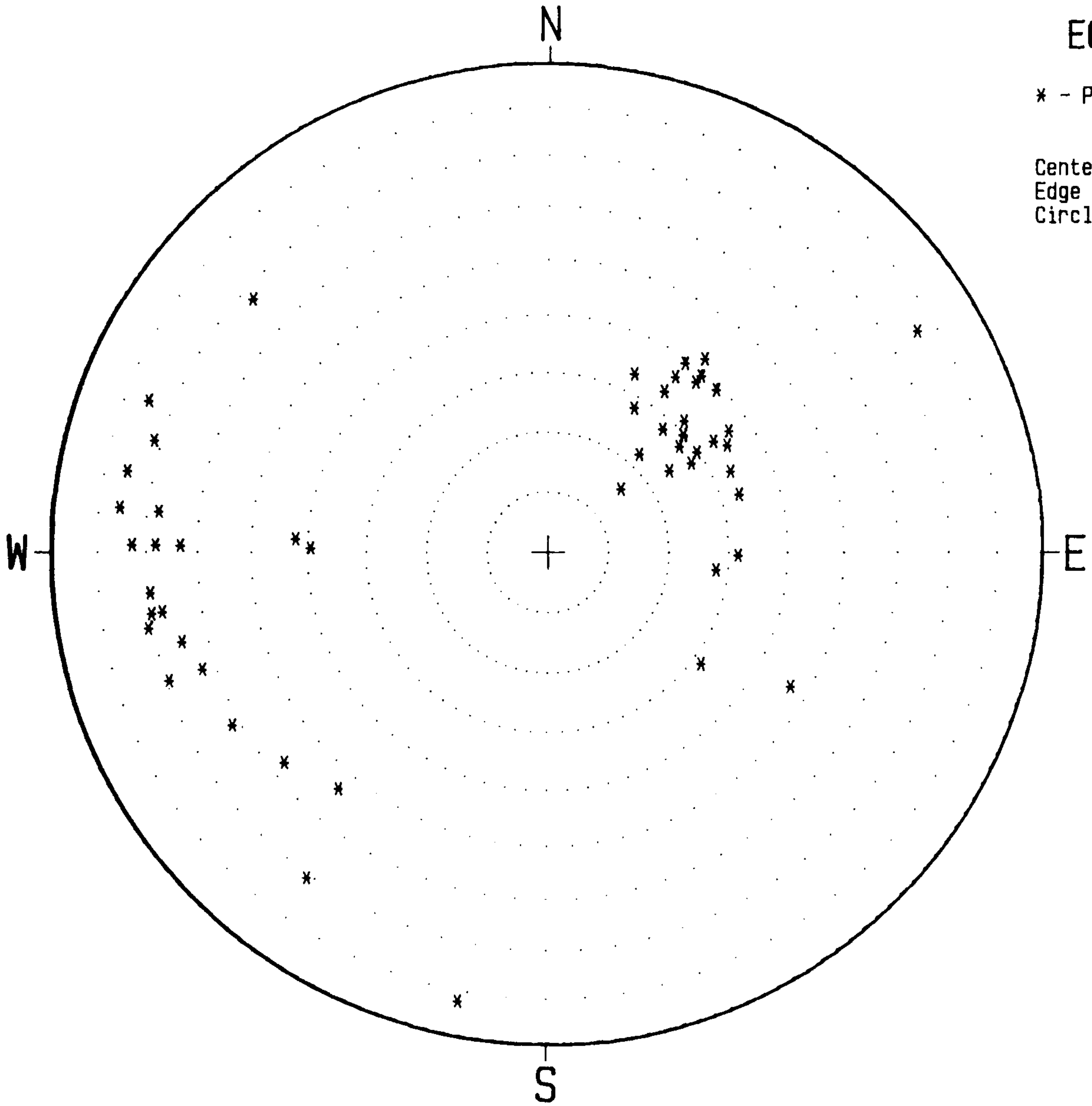
Project Name : Cuchillo Damsite
Drill Hole Name : CU-3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
						Start photography at 96.7 feet.
1	96.37	241.00	61.55	0.0114	Open	Mostly filled with lt min.
6	95.59	46.00	28.06	0.0106	N/A	Bedding Feature
1	94.93	221.00	53.54	0.0143	Open	Mostly filled with lt min.
1	92.65	264.00	69.44	0.0084	Healed	Light mineral filling.
1	91.58	271.00	63.07	0.0544	Healed	Light mineral filling.
1	91.04	251.00	62.58	0.0829	Open	Mostly filled with lt min.
1	88.83	259.00	70.79	0.0197	Open	Mostly filled with lt min.
1	83.43	251.00	69.44	0.1686	Open	This is bottom of a cavity. Cavity to 82.08 feet.
1	79.37	256.00	64.87	0.0510	Open	Mostly filled with lt min.
6	79.03	49.00	29.86	0.0208	N/A	Bedding feature
1	79.03	49.00	29.86	0.2602	Open	Partly filled with lt min.
6	74.19	49.00	39.36	0.0093	N/A	Bedding feature Appears broken
1	72.06	261.00	69.72	0.0042	Healed	Light mineral filling. Bottom estimated
1	70.78	271.00	67.88	0.0090	Healed	Light mineral filling.
1	65.53	291.00	74.84	0.0031	Healed	Light mineral filling.
1	64.49	59.00	34.88	0.0098	Healed	Light mineral filling.
1	64.06	59.00	76.30	0.0028	Healed	Light mineral filling.
1	57.75	273.00	42.06	0.2228	Open	Mostly filled with lt min.
1	57.30	311.00	67.54	0.1604	Open	Mostly filled with lt min.
1	56.37	216.00	70.79	0.0987	Open	Mostly filled with lt min.
1	55.36	73.00	33.27	0.0100	Healed	Light mineral filling.
1	53.21	56.00	24.28	0.0022	Healed	Light mineral filling.
1	51.55	66.00	33.27	0.0050	Healed	Light mineral filling.
1	50.88	119.00	46.83	0.0164	Open	Partly filled with lt min.
1	50.24	271.00	72.64	0.1432	Healed	Light mineral filling.
1	48.12	46.00	39.36	0.0186	Open	
1	46.75	281.00	75.15	0.0769	Open	
1	45.89	91.00	31.60	0.0307	Open	
1	41.31	231.00	57.31	0.0130	Healed	Light mineral filling.
1	39.98	43.00	28.06	0.0318	Open	
1	39.65	261.00	67.54	0.0023	Healed	Light mineral filling.
1	38.55	96.00	28.06	0.0053	Healed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : Cuchillo Damsite
Drill Hole Name : CU-3
Drill Hole Size : NX
Drill Hole Orientation : Vertical

Data Line Code	Depth to Fracture	Azimuth of Fracture	Dip of Fracture	Aperature Fracture (Inches)	Joint Type	Remarks
1	37.57	276.00	67.54	0.0046	Open	Partly filled with lt min. Fracture splits
1	37.15	41.00	37.92	0.0189	Open	
1	35.96	39.00	42.05	0.0089	Open	Partly filled with lt min.
1	34.35	56.00	29.86	0.0208	Healed	Light mineral filling. 2 parallel fractures
1	33.75	58.00	28.06	0.0318	Healed	Light mineral filling.
1	32.47	49.00	16.02	0.0231	Open	Partly filled with lt min.
1	31.31	41.00	39.36	0.0371	Healed	Light mineral filling. 2 parallel fractures
1	29.38	26.00	33.27	0.1003	Healed	Light mineral filling.
1	28.88	56.00	33.27	0.0201	Healed	Light mineral filling.
1	27.66	56.00	36.43	0.0965	Healed	Light mineral filling.
1	26.92	49.00	29.86	0.0520	Healed	Light mineral filling. 2 parallel fractures
1	26.29	51.00	28.06	0.0529	Healed	Light mineral filling.
1	24.59	36.00	36.43	0.0193	Healed	Light mineral filling.
1	24.16	36.00	39.36	0.0464	Healed	Light mineral filling.
1	22.84	46.00	31.60	0.1022	Healed	Light mineral filling.
1	21.01	31.00	28.06	0.0847	Healed	Light mineral filling. 2 parallel fractures
1	20.44	36.00	33.27	0.0100	Healed	Light mineral filling.
6	20.09	36.00	40.73	0.2728	N/A	Bedding feature
1	19.21	286.00	71.29	0.1925	Open	Mostly filled with lt min.
1	18.81	276.00	75.46	0.1205	Open	Mostly filled with lt min.
6	16.89	49.00	31.60	0.1533	N/A	Bedding feature
1	12.88	191.00	82.20	0.0814	Open	
1	9.93	271.00	39.36	0.0928	Open	
1	9.43	43.00	22.30	0.0555	Open	
1	8.11	126.00	31.60	0.1022	Open	
						Rock appears broken End photography at 3.0 feet.

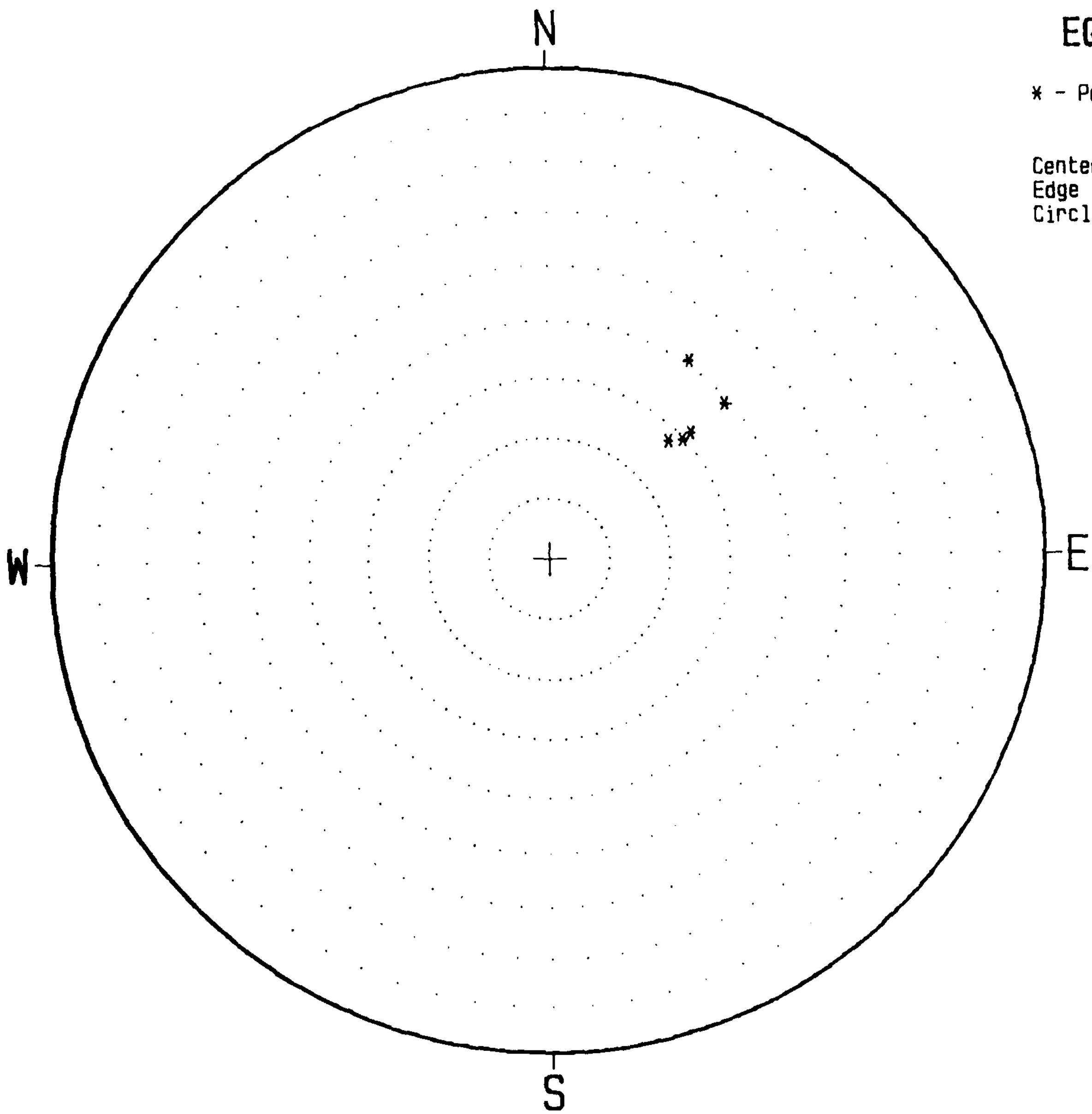


EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name: Cuchillo Damsite	
Drill Hole: CU-3	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	



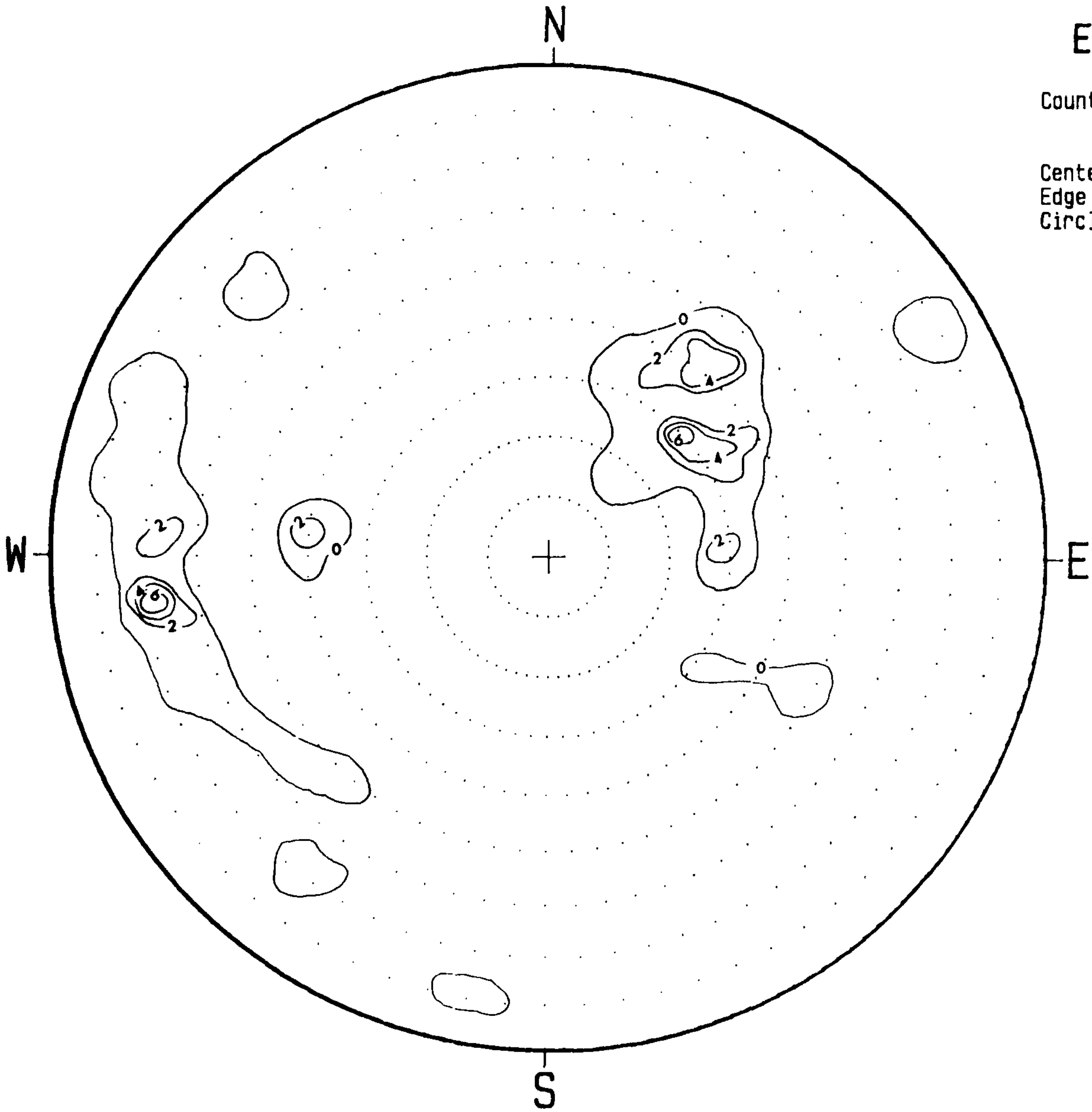
EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

NOTE - Bedding feature

Project Name: Cuchillo Damsite	
Drill Hole: CU-3	Hole Size: NX
Orientation: Vertical	
Direction: 0	Hade: 0
Photographed and Interpreted by the Walla Walla District	



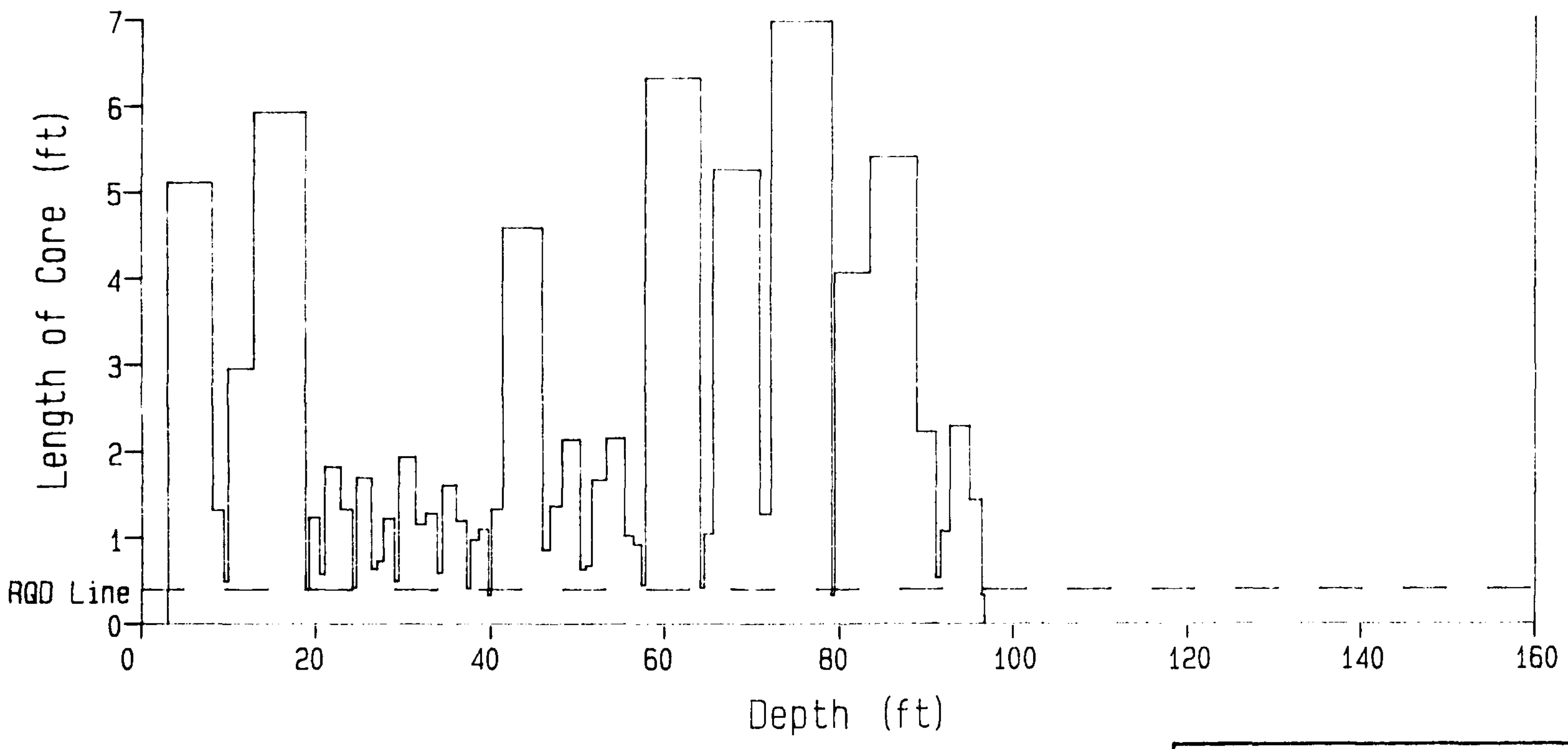
EQUAL AREA POLAR PLOT

Countours represent percent of poles
per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.

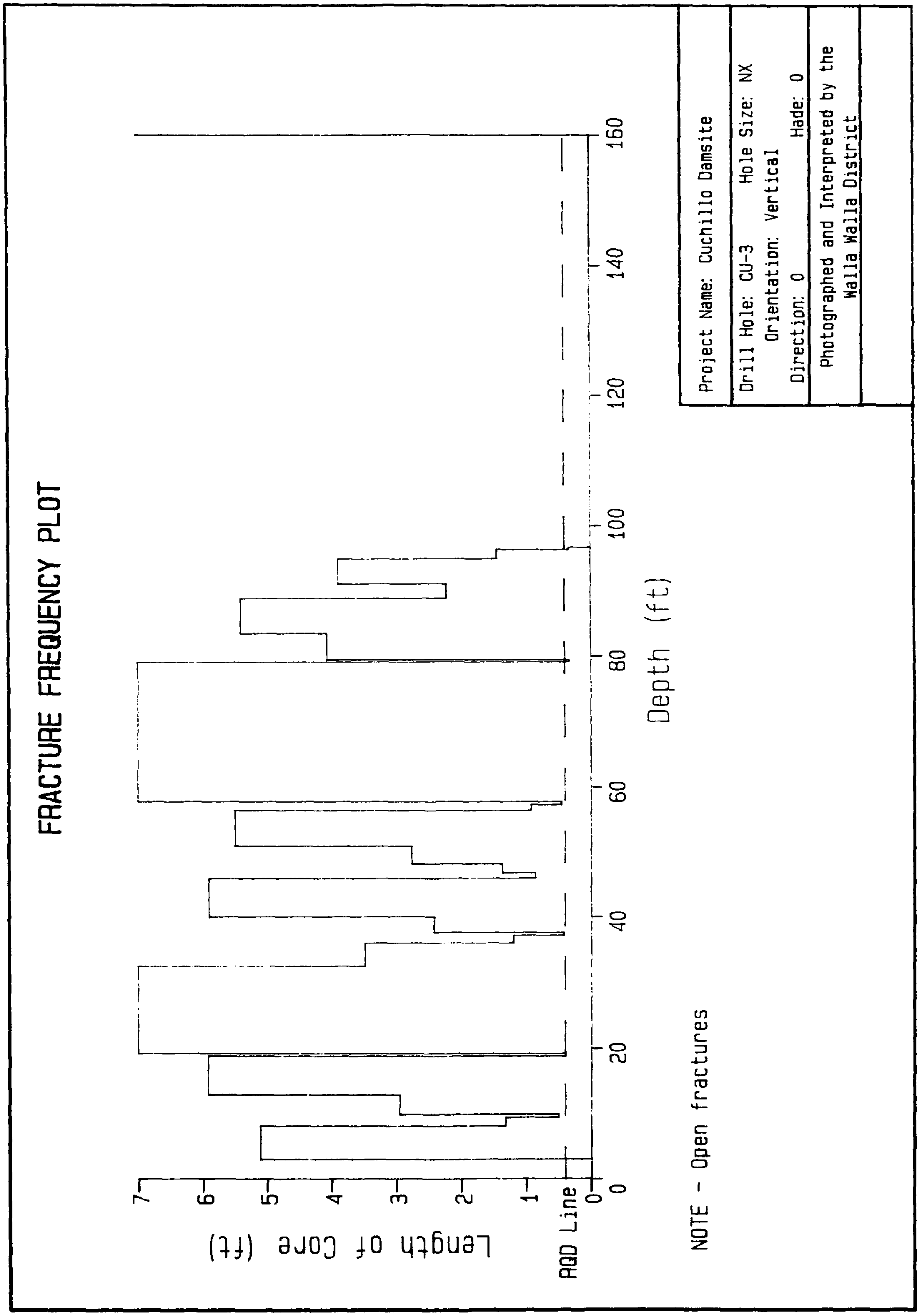
Project Name: Cuchillo Damsite
Drill Hole: CU-3 Hole Size: NX Orientation: Vertical Direction: 0 Hade: 0
Photographed and Interpreted by the Walla Walla District

FRACTURE FREQUENCY PLOT

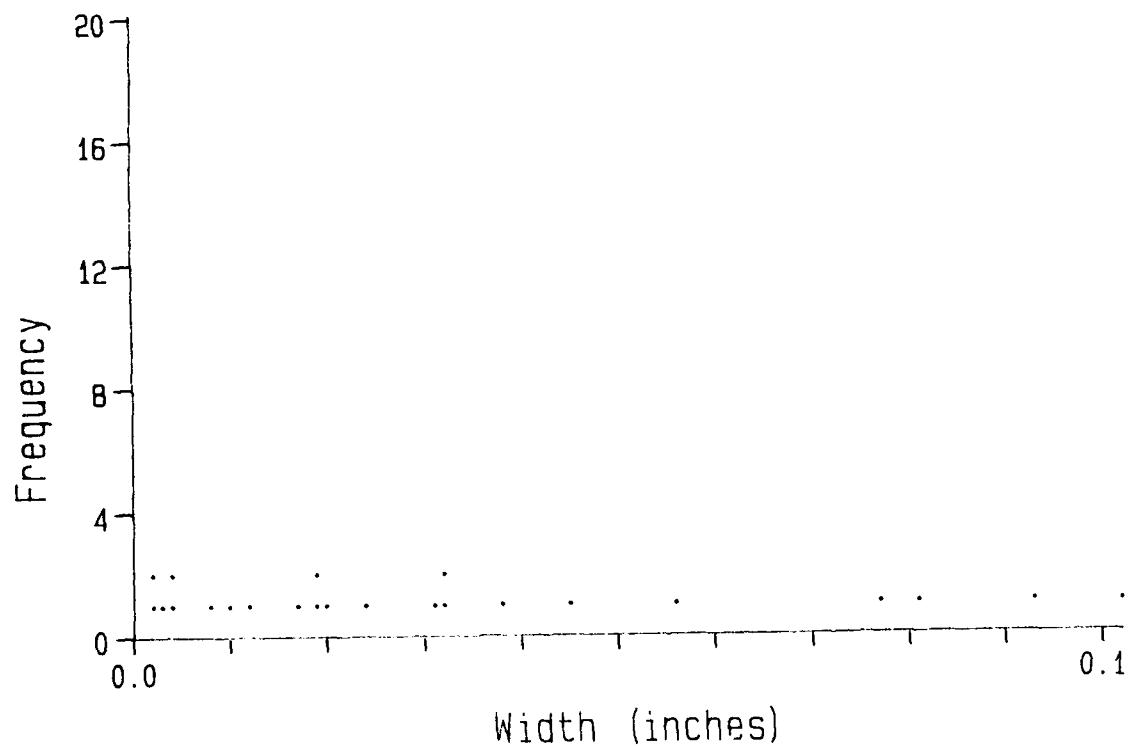


NOTE - All fractures

Project Name: Cuchillo Damsite
Drill Hole: CU-3 Hole Size: NX Orientation: Vertical Direction: 0 Hade: 0
Photographed and Interpreted by the Walla Walla District

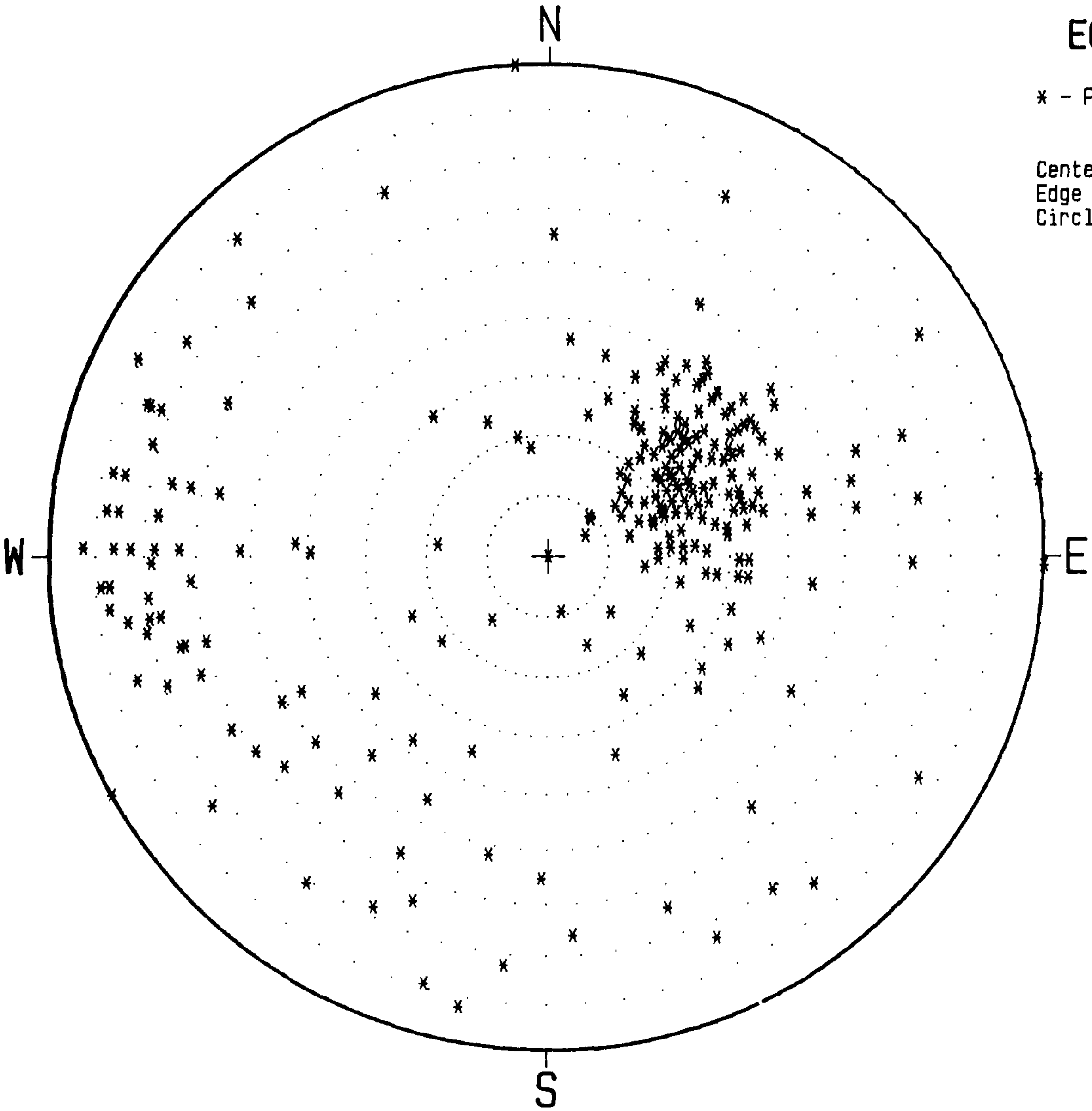

FRACTURE FREQUENCY PLOT
Length of Core (ft)
RQD Line
Depth (ft)
0
20
40
60
80
100
120
140
160
1
2
3
4
5
6
7
NOTE - Open fractures
Project Name: Cuchillo Damsite
Drill Hole: CU-3 Hole Size: NX
Orientation: Vertical
Direction: 0 Hade: 0
Photographed and Interpreted by the
Walla Walla District

APERATURE DISTRIBUTION



There are 2 fractures not graphed.
Largest aperature width = .17 inches.
Median aperature width = .024 inch.

Project Name: Cuchillo Damsite
Drill Hole: CU-3 Hole Size: NX Orientation: Vertical Direction: 0 Hade: 0
Photographed and Interpreted by the Walla Walla District



EQUAL AREA POLAR PLOT

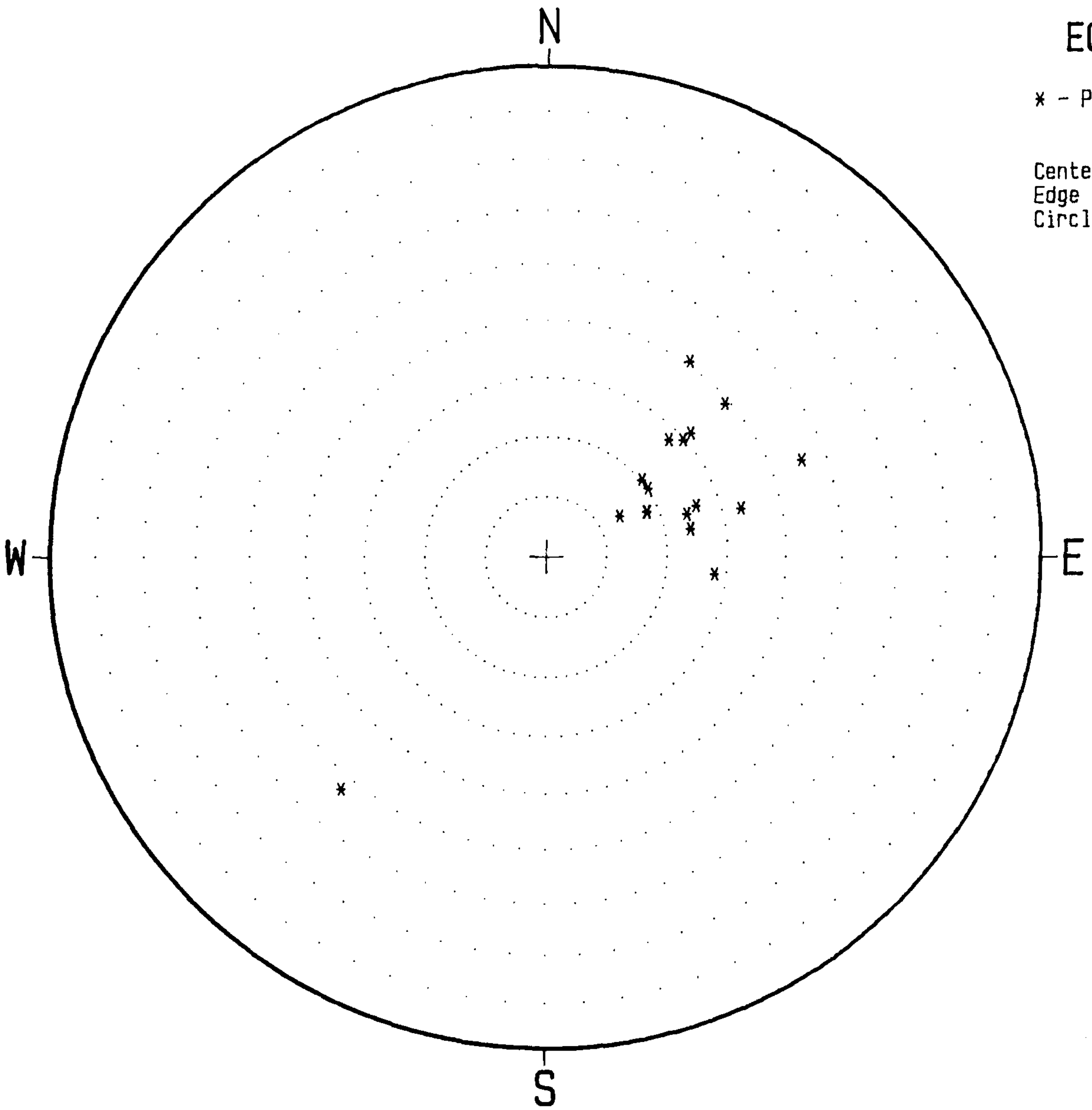
* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

COMPOSITE GROUP

CU-1 CU-2
CU-3

Project Name: Cuchillo Damsite
Drill Hole: Composite Hole Size: N/A Orientation: N/A Direction: N/A Hade: N/A
Photographed and Interpreted by the Walla Walla District



EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

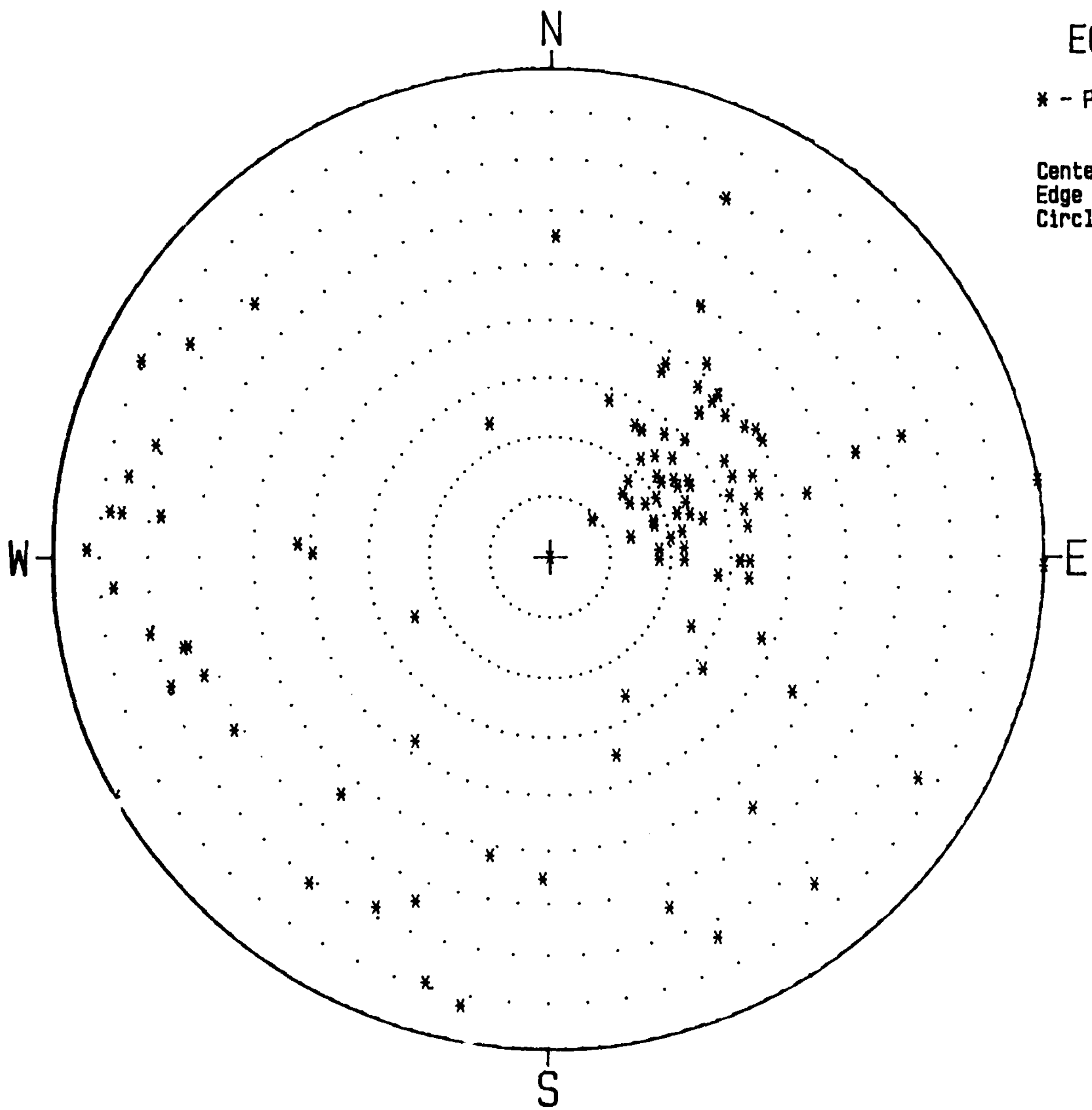
Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

COMPOSITE GROUP

CU-3 CU-2
CU-3

NOTE - Bedding features

Project Name: Cuchillo Damsite
Drill Hole: Composite Hole Size: N/A Orientation: N/A Direction: N/A Hade: N/A
Photographed and Interpreted by the Walla Walla District



EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

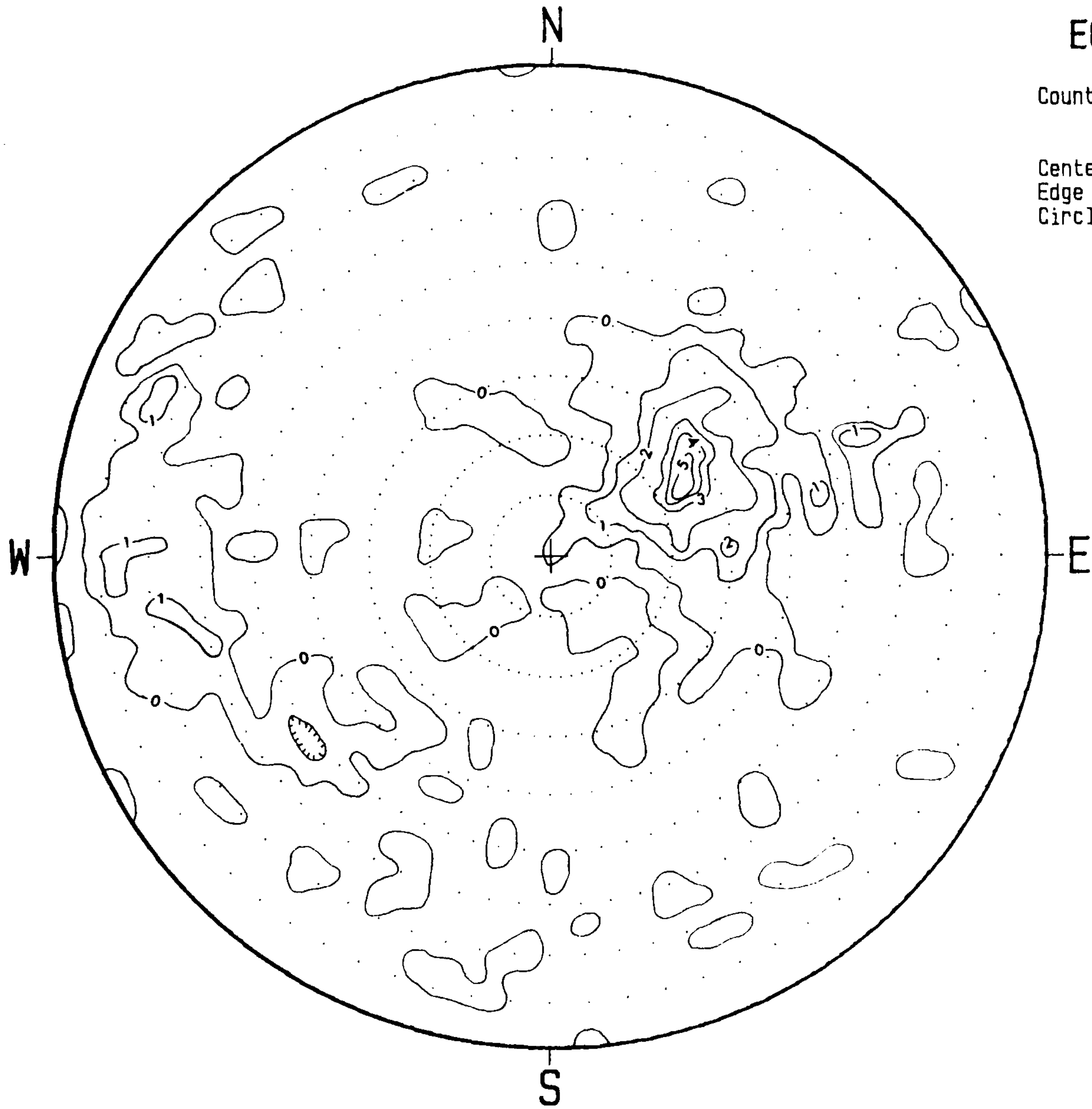
Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

COMPOSITE GROUP

CU-1 CU-2
CU-3

NOTE - Open fractures only !!

Project Name: Cuchillo Damsite	
Drill Hole: Composite	Hole Size: N/A
Orientation: N/A	
Direction: N/A	Hade: N/A
Photographed and Interpreted by the Walla Walla District	



EQUAL AREA POLAR PLOT

Countours represent percent of poles
per 1% counting area.

Center of plot equals 0 degrees dip.
Edge of plot equals 90 degrees dip.
Circles represent 10 degree increments of dip.

COMPOSITE GROUP

CU-1 CU-2
CU-3

Project Name: Cuchillo Damsite

Drill Hole: Composite Hole Size: N/A
Orientation: N/A
Direction: N/A Hade: N/A

Photographed and Interpreted by the
Walla Walla District

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14843-1 (11 pages)

PROJECT: CUCHILLO NEGRO DAM SITE Feature: VIDEO INVESTIGATIONS OF SELECTED BOREHOLES	Contract No.
TEST REQUEST NO.: E86890041 Dated: 13 March 89 Received: 15 March 1989	From: Chief Geotechnical Branch Albuquerque District

Identification:

BOREHOLES CH-29, CH-30 and D-1

REMARKS:

SEE ATTACHED PAGES.

Report sent to: Albuquerque District	Copy furnished:

Date: 15 May 89	Name and title: WILLIAM R. TANNER Director SWD Laboratory	Signature

CUCHILLO NEGRO DAM SITE
ALBUQUERQUE DISTRICT
VIDEO CAMERA INVESTIGATION
SWDED-GL REPORT NO. 14843-1

1. REFERENCE: Reference is made to Albuquerque District test request E86890041, dated 13 March 1989, requesting video camera investigations of selected borings.

2. REPORT: Attached are the results of the findings of this field investigation.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-29
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
0.0					Start video. Orientation data not available because rough hole walls only allowed use of the downward viewing camera head.
41.4					Bottom of casing.
42.0					Top of breakout.
42.8					Bottom of breakout.
44.0					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
46.1					End of broken zone.
46.5					Top of breakout.
47.0					Bottom of breakout.
48.4					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
50.5					Bottom of broken zone, top of sound rock, no open joints. zone; rock broken, fragmented and
51.7					Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
54.2					Bottom of broken zone, top of sound rock, no open joints.
57.1					Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
60.9					Bottom of broken zone, top of sound rock, no open joints.
61.5					Bottom of sound rock, top of broken

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-29
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
63.4					Bottom of broken zone, top of sound rock, no open joints.
63.8					Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
70.4					Bottom of broken zone, top of sound rock, no open joints, argillaceous zone 71.2'-71.6 .
72.2					Bottom of sound zone, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
74.4					Bottom of broken zone, top of argillaceous zone, boring walls intact, no open fractures.
75.2					Bottom of argillaceous zone, top of sound rock, no open joints.
76.2					Open joints appear, almost horizontal.
77.2					Open low angle joints.
77.4					Open low angle joints.
77.8					Open low angle joints.
78.5					Open low angle joints.
78.7					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
83.5					Bottom of broken zone.
81.8					Top of argillaceous zone, boring wall intact, rock appears competent.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-29
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
84.4					Open appearing joints.
85.4					Open appearing joints.
87.6					Open appearing joints.
89.0					Open appearing joints.
89.1					Rock becoming darker, not as weathered, but still argillaceous and sound.
89.2					Breakout along open joint.
89.4					Breakout along open joint.
90.1					Joint, appears open.
92.1					Top of three parallel joints, possibly open.
92.5					Bottom of joints.
97.3					Tight joint.
98.1					Bottom of argillaceous zone, top of transition zone, alternating argillaceous and nonargillaceous zones.
100.0					Bottom of transition zone, top of argillaceous zone, boring walls intact but rough.
103.3					Rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
104.5					Bottom of argillaceous and broken zones.
105.5					Tight joint.
105.8					Rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
109.4					Bottom of broken zone, top of sound rock.
109.8					Bottom of sound rock, top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
113.4					Bottom of broken zone.
114.0					Joints, possibly open.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-29
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
114.4					Joints, possibly open.
115.3					Joints, possibly open.
115.5					Joints, possibly open; top of argillaceous zone, boring walls intact but rough.
117.8					Breakout, bottom of argillaceous zone.
119.1					Top of broken zone; rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
138.2					Bottom of broken zone, top of argillaceous limestone, boring walls intact but rough, breakout at 140.5 .
143.7					Bottom of limestone, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-30
Drill Hole Size : 4
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					Boring drilled with air; 0.0'-2.5', 6 inch diameter, 2.5'-bottom, 4 inch diameter.
2.5					Bottom of casing.
10.9					Top of breakout, boring enlarged, probably due to drilling action.
11.6					Bottom of breakout.
14.5					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
18.2					Bottom of cavity.
21.5					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
23.2					Bottom of cavity.
26.1					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
28.0					Bottom of cavity.
32.0	120	61	0.0291	Healed	Light mineral filling.
34.5					Top of broken zone.
34.7					Bottom of broken zone.
34.0	75	86	0.0090	Healed	Light mineral filling.
39.8	90	72	0.0190	Healed	Light mineral filling.
43.6	0	50	0.0192	Healed	Light mineral filling.
55.5	45	50	0.0832	Healed	Light mineral filling.
62.3	45	42	0.0966	Healed	Light mineral filling.
63.3	270	70	0.0868	Healed	Light mineral filling.
67.9	290	56	0.0111	Healed	Light mineral filling.
69.2	45	42	--	Tight	Hairline.
73.4	295	67	0.0115	Healed	Light mineral filling.
81.2					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls

BOREHOLE ANALYSIS
Output Data

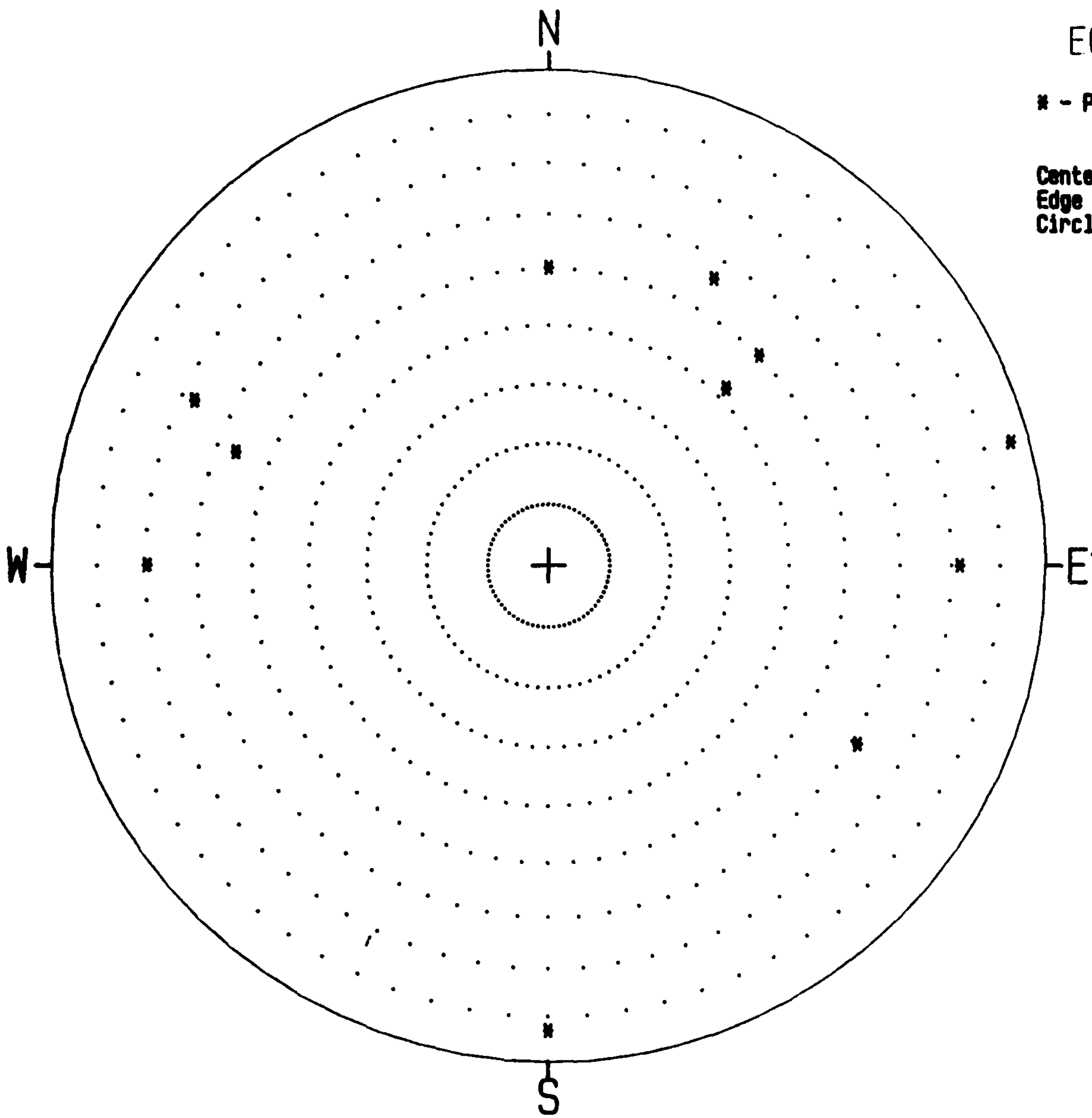
Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING CH-30
Drill Hole Size : 4
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					extremely rough, jagged and cavitated, no orientation.
86.7					Bottom of cavity.
89.7					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
93.0					Bottom of cavity.
94.0					Top of cavity, rock broken, fragmented and weathered, boring enlarged, walls extremely rough, jagged and cavitated, no orientation.
96.4					Bottom of cavity, top of dark argillaceous zone, boring walls rough, some breakouts noted, numerous hairline tight fractures to 0.03 inch wide with dip azimuths around 45 degrees.
130.6					Top of cavity.
132.0					Bottom of cavity.
136.0					Bottom of dark argillaceous zone, top of lithology change, lighter color and different texture, chalky appearance.
141.7					Boring becomes enlarged, rock broken.
145.0					Bottom of broken zone and light zone, lithology changes to dark argillaceous limestone.
145.9	180	83	0.0037	Healed	Light mineral filling.
149.1	30	56	0.1387	Healed	Light mineral filling.
151.0					Bottom of limestone, lithology changes, lighter color and different texture, chalky appearance.
155.0					Bottom of light zone, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING D-1
Drill Hole Size : 6
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
9.6					Bottom of casing.
11.3	150	22	--	Tight	Hairline.
14.9	30	45	--	Tight	Hairline.
25.7	45	50	--	Tight	Hairline.
31.8					Top of rough argillaceous zone.
36.0					Bottom of rough argillaceous zone.
32.1	40	50	--	Tight	Hairline.
34.7	45	39	--	Tight	Hairline
49.1					Top of breakout.
49.8					Bottom of breakout zone.
56.6	45	39	--	Tight	Hairline.
58.1	45	39	--	Tight	Hairline.
59.2					Top of breakout on SW side of boring.
61.3					Bottom of breakout on SW side of boring.
63.6					Top of cavity, boring enlarged, rock weathered, broken and fractured.
65.2					Bottom of cavity.
65.0	45	39	--	Tight	Hairline.
66.1	45	39	0.3904	Healed	Dark mineral filling.
67.1	210	31	0.0514	Healed	Dark mineral filling.
67.6	75	31	0.4287	Healed	Dark mineral filling.
71.7	45	50	--	Tight	Hairline.
73.6	45	45	--	Tight	Hairline.
75.8	45	39	0.1015	Healed	Dark mineral filling.
76.3	45	45	--	Tight	Hairline.
77.8	270	75	0.0153	Healed	Light mineral filling.
77.2	45	39	--	Tight	Hairline.
79.8	0	31	0.2144	Healed	Light mineral filling.
81.8	45	54	--	Tight	Hairline
85.4	45	31	--	Tight	Hairline.
85.8					Top of cavity.
87.6					Bottom of cavity.
88.4					Top of cavity, boring enlarged, rock weathered, broken and friable.
94.0					Bottom of cavity, end of video.

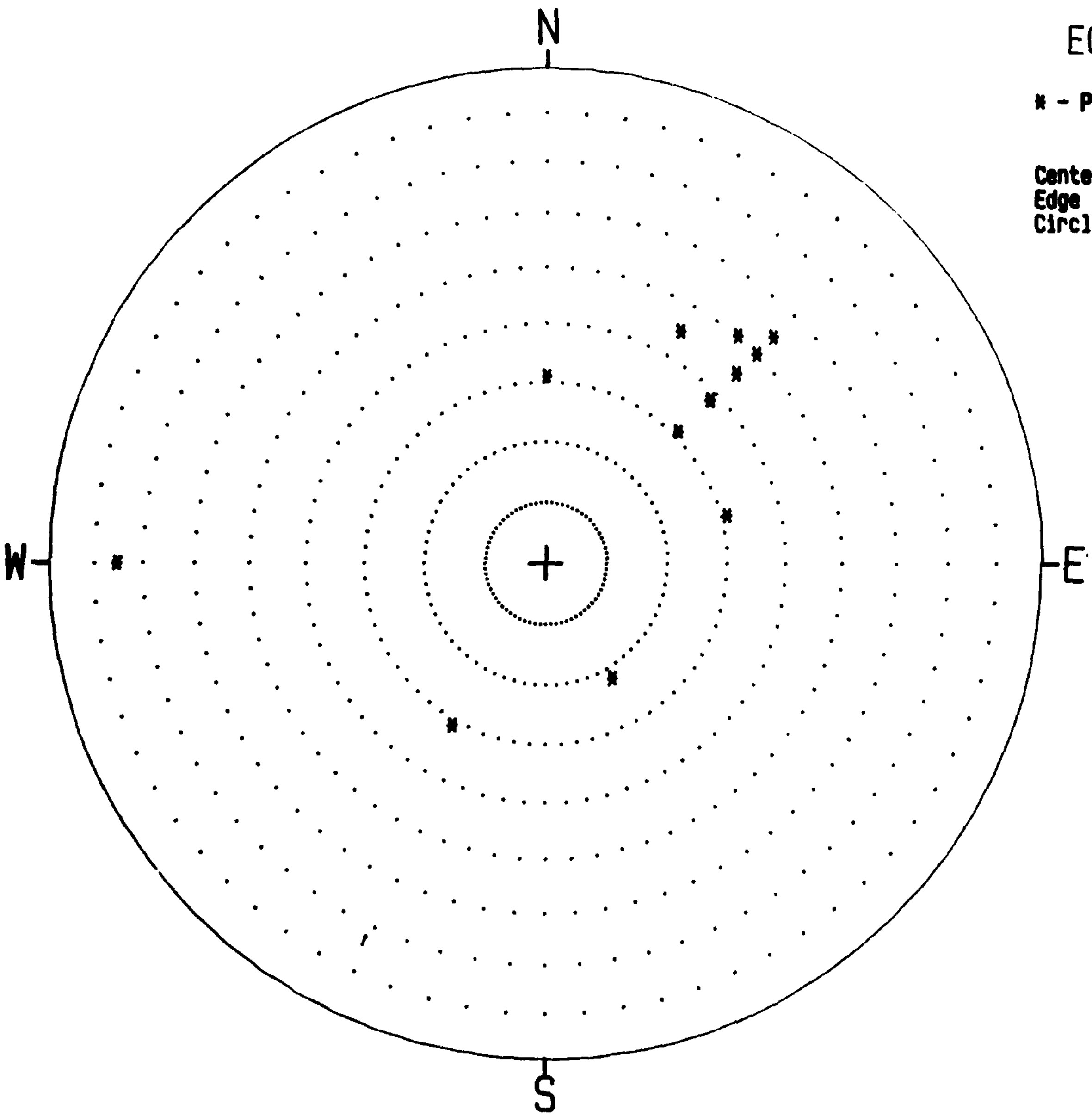


EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name :CUCHILLO NEGRO DAM	
Drill Hole :CH-30	Hole Size : 4
Orientation :Vertical	
Direction :0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	



EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : CUCHILLO NEGRO DAM	
Drill Hole : D-1	Hole Size : 6
Orientation : Vertical	
Direction : 0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	

SOUTHWESTERN DIVISION LABORATORY, CORPS OF ENGINEERS
4815 Cass Street
Dallas, Texas 75235

SUBMITTAL OF SWDED-GL REPORT 14843 (28 pages)

PROJECT: CUCHILLO NEGRO DAM SITE Feature: VIDEO INVESTIGATIONS OF SELECTED BOREHOLES	Contract No.
TEST REQUEST NO.: E86890041 Dated: 13 March 89 Received: 15 March 1989	From: Chief Geotechnical Branch Albuquerque District

Identification:

BOREHOLES 19, 20, 21, 22, 23 and 26.

REMARKS:

SEE ATTACHED PAGES.

Report sent to: Albuquerque District	Copy furnished:

Date:	Name and title:	Signature
18 Apr 89	WILLIAM R. TANNER Director SWD Laboratory	W R Tanner

CUCHILLO NEGRO DAM SITE
ALBUQUERQUE DISTRICT
VIDEO CAMERA INVESTIGATION
SWDED-GL REPORT NO. 14843

1. REFERENCE: Reference is made to Albuquerque District test request E86890041, dated 13 March 1999, requesting video camera investigations of selected borings.

2. REPORT: Attached are the results of the findings of this field investigation.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 19
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
1.3	1.3				Start video
19.5	19.9	60	0.1300	Closed	Light mineral filling.
23.2	23.4	265	0.0100	Tight	
23.4	23.7	50	0.0200	Closed	Light mineral filling.
27.1	27.5	45	0.0600	Open	
19.5	19.5				Rough zone, argillaceous, weathered
30.1	30.1				Bottom of rough zone, top of sound rock
38.0	38.5	280	0.0600	Closed	Light mineral filling.
40.9	41.4	280	0.0600	Closed	Light mineral filling.
41.0	41.3	50	0.0600	Closed	Light mineral filling.
41.5	41.9	80	0.0600	Closed	Light mineral filling.
43.4	44.4	180	0.1300	Closed	Light mineral filling.
51.9	51.9				Rough zone, weathered, argillaceous
54.2	54.2				Bottom of rough zone
55.9	55.9				Top of cavity
57.0	57.0				Bottom of cavity
58.6	59.0	45	0.0000	Tight	Hairline
60.7	61.3	240	0.0000	Tight	Hairline
61.2	61.2				Top of cavity.
63.5	63.5				Bottom of cavity.
63.6	63.8	210	0.0000	Closed	Hairline.
63.6	63.8	255	0.0000	Closed	Hairline.
63.8	64.2	45	0.0600	Closed	Light mineral filling. Bedding noted.
64.3	64.7	45	0.0300	Closed	Light mineral filling.
65.1	65.4	45	0.0300	Closed	Light mineral filling.
65.9	66.3	45	0.0300	Closed	Light mineral filling.
67.0	67.6	35	0.2500	Closed	Light mineral filling.
67.8	68.9	260	0.0300	Open	Breakout, boring enlarged.
69.8	70.2	45	0.0300	Open	Broken along fracture plane.
69.8	70.2	45	0.0300	Open	Broken along fracture planes.
70.8	71.4	255	0.0600	Closed	Light mineral filling.
71.1	71.7	250	0.1300	Closed	Light mineral filling.
73.2	73.5	45	0.0600	Closed	Light mineral filling.
74.5	74.8	45	0.0600	Closed	Light mineral filling.
75.9	76.2	45	0.0600	Closed	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 19
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
77.7	78.2	45	0.5000	Tight	Light mineral filling. Some rock broken due to drilling.
79.0	79.6	270	0.4000	Tight	Light mineral filling. Rock broken, some missing along plane.
80.3	80.8	30	0.3000	Open	
82.2	82.2				Top of cavity.
85.0	85.0				Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 19
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
1.3					Start video
19.7	60	52	0.0805	Closed	Light mineral filling.
23.3	265	32	0.0084	Tight	
23.5	50	44	0.0145	Closed	Light mineral filling.
27.3	45	52	0.0371	Open	
19.5					Rough zone, argillaceous, weathered
30.1					Bottom of rough zone, top of sound rock
38.3	280	58	0.0320	Closed	Light mineral filling.
41.2	280	58	0.0320	Closed	Light mineral filling.
41.2	50	44	0.0435	Closed	Light mineral filling.
41.7	80	52	0.0371	Closed	Light mineral filling.
43.9	180	73	0.0391	Closed	Light mineral filling.
51.9					Rough zone, weathered, argillaceous
54.2					Bottom of rough zone
55.9					Top of cavity
57.0					Bottom of cavity
58.8	45	52	0.0000	Tight	Hairline
61.0	240	62	0.0000	Tight	Hairline
61.2					Top of cavity.
63.5					Bottom of cavity.
63.7	210	32	0.0000	Closed	Hairline.
63.7	255	32	0.0000	Closed	Hairline.
64.0	45	52	0.0371	Closed	Light mineral filling. Bedding noted.
64.5	45	52	0.0186	Closed	Light mineral filling.
65.3	45	44	0.0217	Closed	Light mineral filling.
66.1	45	52	0.0186	Closed	Light mineral filling.
67.3	35	62	0.1163	Closed	Light mineral filling.
68.3	260	74	0.0083	Open	Breakout, boring enlarged.
70.0	45	52	0.0186	Open	Broken along fracture plane.
70.0	45	52	0.0186	Open	Broken along fracture planes.
71.1	255	62	0.0279	Closed	Light mineral filling.
71.4	250	62	0.0605	Closed	Light mineral filling.
73.3	45	44	0.0435	Closed	Light mineral filling.
74.7	45	44	0.0435	Closed	Light mineral filling.
76.1	45	44	0.0435	Closed	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 19
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
77.9	45	58	0.2666	Tight	Light mineral filling. Some rock broken due to drilling.
79.3	270	62	0.1860	Tight	Light mineral filling. Rock broken, some missing along plane.
80.6	30	58	0.1600	Open	
82.2					Top of cavity.
85.0					Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
6.3	6.3				Bottom of casing.
8.1	8.4	135	0.0200	Open	
10.5	10.8	0	0.0200	Ptly Open	
20.3	21.5	100	0.0600	Ptly Open	Rock broken and some missing.
21.7	22.3	180	0.0600	Ptly Open	Rock broken and some missing.
29.0	29.0				Rock broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
50.3	50.3				Bottom of broken zone.
51.6	52.0	90	0.0600	Tight	Bedding visible.
52.2	52.2				Rough zone, argillaceous.
52.6	52.6				Bottom of rough zone.
54.1	54.7	40	0.0100	Tight	
54.7	54.7				Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
60.8	60.8				Bottom of broken zone.
61.7	62.0	45	0.0200	Tight	
62.7	62.7				Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
66.2	66.2				Bottom of rough zone.
66.3	67.0	45	0.0100	Tight	Fractures, rock broken along fracture plane.
67.6	67.6				Boring walls intact, but rough, argillaceous zone.
71.7	71.7				Bottom of argillaceous zone, top of cavity on SE side of boring wall.
75.6	75.6				Bottom of cavity, boring walls intact, but rough with some small break outs, probably due to drilling rock, argillaceous.
81.3	81.3				Bottom of argillaceous zone, rock is

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					highly broken, boring enlarged walls are extremely rough, jagged and cavitated, no orientations.
89.0	89.0				Bottom of broken zone, blocked, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
6.3					Bottom of casing.
8.3	135	44	0.0145	Open	
10.6	0	44	0.0145	Ptly Open	
20.9	100	75	0.0152	Ptly Open	Rock broken and some missing.
22.0	180	62	0.0279	Ptly Open	Rock broken and some missing.
29.0					Rock broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
50.3					Bottom of broken zone.
51.8	90	52	0.0371	Tight	Bedding visible.
52.2					Rough zone, argillaceous.
52.6					Bottom of rough zone.
54.4	40	62	0.0047	Tight	
54.7					Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
60.8					Bottom of broken zone.
61.8	45	44	0.0145	Tight	
62.7					Rocks broken, fragmented and weathered, boring enlarged walls are extremely rough, jagged and cavitated, no orientation.
66.2					Bottom of rough zone.
66.7	45	66	0.0041	Tight	Fractures, rock broken along fracture plane.
67.6					Boring walls intact, but rough, argillaceous zone.
71.7					Bottom of argillaceous zone, top of cavity on SE side of boring wall.
75.6					Bottom of cavity, boring walls intact, but rough with some small break outs, probably due to drilling rock, argillaceous.
81.3					Bottom of argillaceous zone, rock is

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 20
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					highly broken, boring enlarged walls are extremely rough, jagged and cavitated, no orientations.
89.0					Bottom of broken zone, blocked, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
19.7	19.7				Bottom of casing.
20.0	20.0				Cavity, rock broken, weathered, no orientation.
21.1	21.1				Bottom of cavity.
24.3	25.1	270	0.0100	Tight	
25.1	25.5	45	0.0100	Tight	
30.4	30.6	45	0.0100	Tight	Bedding visible.
31.0	31.3	45	0.0100	Tight	
32.6	32.8	45	0.0100	Tight	
42.8	43.1	45	0.0300	Ptly Open	
42.8	42.8				Numerous light mineral filled stringers and hairline tight fractures dip azimuths 45 and 270 degrees.
50.0	50.2	45	0.0300	Ptly Open	
52.3	52.6	0	0.0200	Ptly Open	
53.0	54.7	300	0.1300	Open	
61.6	62.1	250	0.1300	Closed	Light mineral filling.
63.1	63.6	45	0.0200	Ptly Open	
63.8	64.5	70	0.0200	Ptly Open	
64.6	64.9	45	0.0100	Tight	
64.8	65.2	45	0.0100	Tight	
66.7	67.0	30	0.0100	Tight	
74.1	74.3	45	0.0200	Ptly Open	
77.1	77.5	35	0.4000	Ptly Open	Top of broken zone.
77.5	77.9	35	0.0000	Open	Bottom of broken zone, boring enlarged.
85.0	85.0				Top of cavity.
87.8	87.8				Bottom of cavity.
88.4	88.8	45	0.1300	Closed	Light mineral filling.
94.9	95.1	45	0.2500	Closed	Light mineral filling.
98.1	99.0	225	0.4000	Closed	Light mineral filling.
98.8	99.1	45	0.1300	Closed	Light mineral filling.
100.2	100.7	90	0.0600	Ptly Open	Light mineral filling.
101.8	102.1	45	0.0300	Ptly Open	
104.5	104.8	45	0.0200	Ptly Open	Light mineral filling.
105.7	106.0	65	0.6000	Open	Rock broken.
109.2	111.0	225	0.7000	Ptly Open	Light mineral filling.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
113.2	113.5	40	0.0100	Tight	
117.6	117.9	45	0.0100	Tight	Rough due to drill action.
125.1	126.5	45	0.0100	Tight	Rough zone, possilby argillaceous, some rock missing.
126.6	126.6				Top of cavity, rock broken. 45 degree dip azimuth.
127.6	127.6				Bottom of cavity.
127.8	127.8				Rough zone, some rock broken and missing, possibly argillaceous.
128.4	128.8	45	0.0200	Open	Complex numerous hairline tight connecting fractures.
128.7	130.0	45	0.0300	Tight	To partially open.
130.0	130.0				Top of cavity.
131.0	131.0				Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
19.7					Bottom of casing.
20.0					Cavity, rock broken, weathered, no orientation.
21.1					Bottom of cavity.
24.7	270	68	0.0037	Tight	
25.3	45	52	0.0062	Tight	
30.5	45	32	0.0084	Tight	Bedding visible.
31.1	45	44	0.0072	Tight	
32.7	45	32	0.0084	Tight	
43.0	45	44	0.0217	Ptly Open	
42.8					Numerous light mineral filled stringers and hairline tight fractures dip azimuths 45 and 270 degrees.
50.1	45	32	0.0253	Ptly Open	
52.5	0	44	0.0145	Ptly Open	
53.8	300	79	0.0237	Open	
61.8	250	58	0.0693	Closed	Light mineral filling.
63.3	45	58	0.0107	Ptly Open	
64.2	70	66	0.0082	Ptly Open	
64.8	45	44	0.0072	Tight	
65.0	45	52	0.0062	Tight	
66.8	30	44	0.0072	Tight	
74.2	45	32	0.0169	Ptly Open	
77.3	35	52	0.2476	Ptly Open	Top of broken zone.
77.7	35	52	0.0000	Open	Bottom of broken zone, boring enlarged.
85.0					Top of cavity.
87.8					Bottom of cavity.
88.6	45	52	0.0805	Closed	Light mineral filling.
95.0	45	32	0.2111	Closed	Light mineral filling.
98.6	225	71	0.1322	Closed	Light mineral filling.
98.9	45	44	0.0942	Closed	Light mineral filling.
100.4	90	58	0.0320	Ptly Open	Light mineral filling.
101.9	45	44	0.0217	Ptly Open	
104.7	45	44	0.0145	Ptly Open	Light mineral filling.
105.8	65	44	0.4346	Open	Rock broken.
110.1	225	80	0.1207	Ptly Open	Light mineral filling.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 21
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
113.3	40	44	0.0072	Tight	
117.8	45	44	0.0072	Tight	Rough due to drill action.
125.8	45	77	0.0022	Tight	Rough zone, possilby argillaceous, some rock missing.
126.6					Top of cavity, rock broken, 45 degree dip azimuth.
127.6					Bottom of cavity.
127.8					Rough zone, some rock broken and missing, possibly argillaceous.
128.6	45	52	0.0124	Open	Complex numerous hairline tight connecting fractures.
129.4	45	76	0.0071	Tight	To partially open.
130.0					Top of cavity.
131.0					Bottom of cavity, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 22
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
0.0	0.0				Bottom of casing, boring walls sound, no broken zones or cavities.
54.3	54.6	45	0.2500	Ptly Open	Rock broken.
91.5	92.4	45	0.2500	Open	Rock broken along fracture plane.
93.9	93.9				Cloudy water, end of video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 22
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
0.0					Bottom of casing, boring walls sound, no broken zones or cavities.
54.5	45	44	0.1811	Ptly Open	Rock broken.
91.9	45	71	0.0826	Open	Rock broken along fracture plane.
93.9					Cloudy water, end of video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : CH-23
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
25.4	25.4				Start video.
27.9	27.9				Bottom of casing.
28.7	28.9	45	0.0000	Tight	Hairline.
27.9	27.9				Boring walls rough, weathered and argillaceous.
33.0	33.0				Bottom of rough zone.
36.8	37.1	45	0.0000	Tight	Hairline.
39.9	40.6	210	0.0600	Tight	Light mineral filling.
42.0	42.7	255	0.0600	Tight	Light mineral filling.
45.4	45.7	45	0.0300	Open	
47.5	48.9	265	0.0600	Closed	Light mineral filling.
48.2	49.6	265	0.0600	Closed	Light mineral filling.
51.8	52.2	45	0.0000	Tight	Hairline.
52.9	52.9				Top of cavity.
59.8	59.8				Bottom of cavity.
60.5	60.9	90	0.0300	Open	
64.0	64.3	45	0.0000	Tight	Hairline.
64.6	65.0	65	0.0300	Ptly Open	
65.1	65.5	270	0.0000	Tight	Hairline.
65.4	65.8	150	0.0000	Tight	Hairline.
65.4	65.9	150	0.0000	Tight	Hairline.
65.7	65.7				Top of cavity.
67.5	67.5				Bottom of cavity.
68.9	69.7	195	0.1300	Closed	Light mineral filling.
85.4	85.4				Top of cavity.
86.0	86.0				Bottom of cavity.
85.9	86.1	225	0.0000	Tight	Hairline.
87.6	87.6				Cloudy water.
88.4	88.8	30	0.0000	Tight	Hairline.
89.6	89.9	180	0.2500	Closed	Light mineral filling.
94.6	94.6				End video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : CH-23
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
25.4					Start video.
27.9					Bottom of casing.
28.8	45	32	0.0000	Tight	Hairline.
27.9					Boring walls rough, weathered and argillaceous.
33.0					Bottom of rough zone.
37.0	45	44	0.0000	Tight	Hairline.
40.3	210	66	0.0246	Tight	Light mineral filling.
42.3	255	66	0.0246	Tight	Light mineral filling.
45.5	45	44	0.0217	Open	
48.2	265	77	0.0132	Closed	Light mineral filling.
48.9	265	77	0.0132	Closed	Light mineral filling.
52.0	45	52	0.0000	Tight	Hairline.
52.9					Top of cavity.
59.8					Bottom of cavity.
60.7	90	52	0.0186	Open	
64.2	45	44	0.0000	Tight	Hairline.
64.8	65	52	0.0186	Ptly Open	
65.3	270	52	0.0000	Tight	Hairline.
65.6	150	52	0.0000	Tight	Hairline.
65.7	150	58	0.0000	Tight	Hairline.
65.7					Top of cavity.
67.5					Bottom of cavity.
69.3	195	68	0.0477	Closed	Light mineral filling.
85.4					Top of cavity.
86.0					Bottom of cavity.
86.0	225	32	0.0000	Tight	Hairline.
87.6					Cloudy water.
88.6	30	52	0.0000	Tight	Hairline.
89.8	180	44	0.1811	Closed	Light mineral filling.
94.6					End video.

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
10.6	10.6				Bottom of casing.
17.3	17.9		0.0000	Open	Rock broken, no orientation.
20.8	21.1	105	0.0100	Tight	Rock broken and fractured.
22.6	22.8	90	0.0100	Tight	Rock broken and fractured.
22.7	23.0	90	0.0100	Tight	Rock broken and fractured.
29.9	30.2	90	0.0200	Closed	Light mineral stringer.
32.3	37.8	90	0.0200	Tight	Light mineral filling, hairline, numerous fractures and stringers.
33.6	33.7	90	0.1300	Closed	Light mineral filling.
38.3	38.3				Rough sound argillaceous zone, breakout at top contact.
42.6	42.6				Bottom of rough zone, top of sound limestone.
46.8	46.8				Bottom of limestone, top of rough, sound argillaceous limestone.
48.1	48.4		0.2500	Ptly Open	Fracture discontinuous, no orientation.
56.3	56.3				Bottom of rough sound limestone.
59.4	59.6	50	0.1300	Ptly Open	Partly filled with light mineral.
62.8	62.8				Rough argillaceous zone; at 64.2', boring becomes enlarged, some rock missing, boring walls very rough and jagged; 65.6' walls no longer enlarged or broken, but still have rough argillaceous appearance.
66.6	66.6				Bottom of rough zone, top of sound rock.
67.1	67.1				Bottom of sound rock, top of cavity, rock broken, rough and weathered.
68.8	68.8				Bottom of cavity, top of sound limestone.
69.3	69.3				Bottom of limestone, top of rough argillaceous zone.
70.8	70.8				Bottom of rough zone, top of sound limestone.
71.0	71.0				Bottom of limestone, top of cavity, rock is rough, broken out and weathered.
72.3	72.3				Bottom of cavity, top of rough

BOREHOLE ANALYSIS
Input Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Top of Feature	Depth to Bottom of Feature	Apparent Dip Direction	Apparent Width (Inches)	Joint Type	Remarks
					argillaceous zone.
74.8	74.8				Bottom of rough zone, top of sound limestone.
74.7	74.9	65	0.0200	Tight	
76.4	76.4				Bottom of limestone, top of rough, sound argillaceous zone.
76.9	76.9				Breakout, enlarged.
77.1	77.1				Bottom of rough zone and breakout, top of sound limestone.
78.8	78.8				Breakout.
79.2	79.2				Breakout.
79.7	79.7				Breakout.
80.1	80.1				Bottom of limestone, top of rough, broken argillaceous zone, boring enlarged.
90.4	90.4				Bottom of rough zone, top of sound limestone.
91.7	91.7				Bottom of limestone, top of cavity, rock is rough and argillaceous.
94.0	94.0				Bottom of cavity.
93.4	94.4	315	0.1300	Open	
94.5	94.5				Top of sound limestone.
95.3	95.3				Bottom of sound limestone, one side of boring broken out into cavity.
96.3	96.3				Bottom of cavity.
96.8	96.8				Breakout.
97.3	97.3				Breakout.
98.1	98.1				Top of cavity.
99.0	99.0				Bottom of cavity, honey bees crawling on bottom, end video.

BOREHOLE ANALYSIS
Output Data

Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
10.6					Bottom of casing.
17.6		62	0.0000	Open	Rock broken, no orientation.
21.0	105	44	0.0072	Tight	Rock broken and fractured.
22.7	90	32	0.0084	Tight	Rock broken and fractured.
22.9	90	44	0.0072	Tight	Rock broken and fractured.
30.0	90	44	0.0145	Closed	Light mineral stringer.
35.0	90	87	0.0011	Tight	Light mineral filling, hairline, numerous fractures and stringers.
33.7	90	18	0.1239	Closed	Light mineral filling.
38.3					Rough sound argillaceous zone, breakout at top contact.
42.6					Bottom of rough zone, top of sound limestone.
46.8					Bottom of limestone, top of rough, sound argillaceous limestone.
48.3		44	0.1811	Ptly Open	Fracture discontinuous, no orientation.
56.3					Bottom of rough sound limestone.
59.5	50	32	0.1098	Ptly Open	Partly filled with light mineral.
62.8					Rough argillaceous zone; at 64.2', boring becomes enlarged, some rock missing, boring walls very rough and jagged; 65.6' walls no longer enlarged or broken, but still have rough argillaceous appearance.
66.6					Bottom of rough zone, top of sound rock.
67.1					Bottom of sound rock, top of cavity, rock broken, rough and weathered.
68.8					Bottom of cavity, top of sound limestone.
69.3					Bottom of limestone, top of rough argillaceous zone.
70.8					Bottom of rough zone, top of sound limestone.
71.0					Bottom of limestone, top of cavity, rock is rough, broken out and weathered.
72.3					Bottom of cavity, top of rough

BOREHOLE ANALYSIS
Output Data

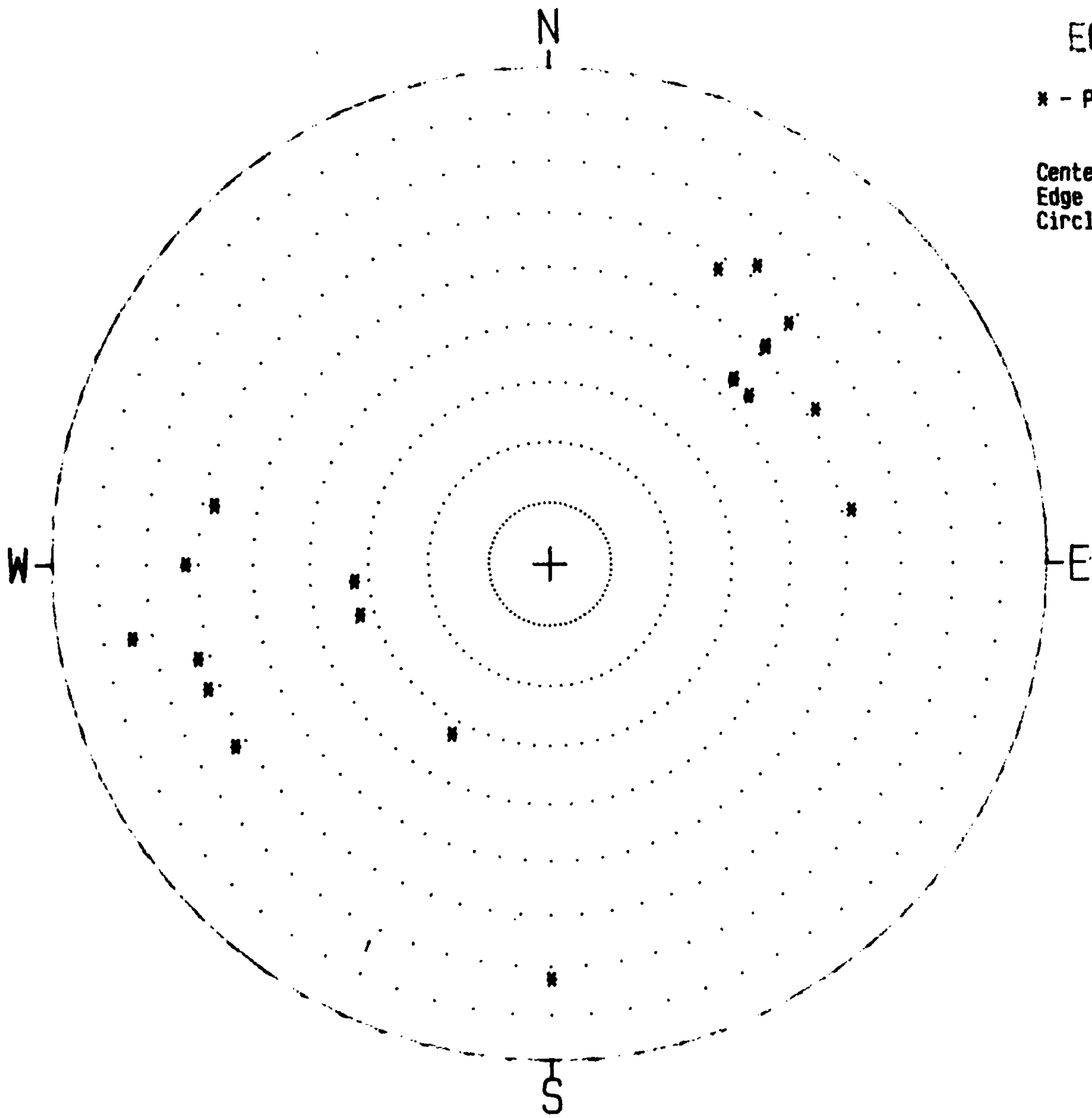
Project Name : CUCHILLO NEGRO DAM
Drill Hole Name : BORING 26
Drill Hole Size : HQ
Drill Hole Orientation : Vertical

Depth to Feature	Dip Direction of Feature	Dip of Feature	Width of Feature (Inches)	Joint Type	Remarks
					argillaceous zone.
74.8				.	Bottom of rough zone, top of sound limestone.
74.8	65	32	0.0169	Tight	
76.4					Bottom of limestone, top of rough, sound argillaceous zone.
76.9					Breakout, enlarged.
77.1					Bottom of rough zone and breakout, top of sound limestone.
78.8					Breakout.
79.2					Breakout.
79.7					Breakout.
80.1					Bottom of limestone, top of rough, broken argillaceous zone, boring enlarged.
90.4					Bottom of rough zone, top of sound limestone.
91.7					Bottom of limestone, top of cavity, rock is rough and argillaceous.
94.0					Bottom of cavity.
93.9	315	73	0.0391	Open	
94.5					Top of sound limestone.
95.3					Bottom of sound limestone, one side of boring broken out into cavity.
96.3					Bottom of cavity.
96.8					Breakout.
97.3					Breakout.
98.1					Top of cavity.
99.0					Bottom of cavity, honey bees crawling on bottom, end video.

EQUAL AREA POLAR PLOT

* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM

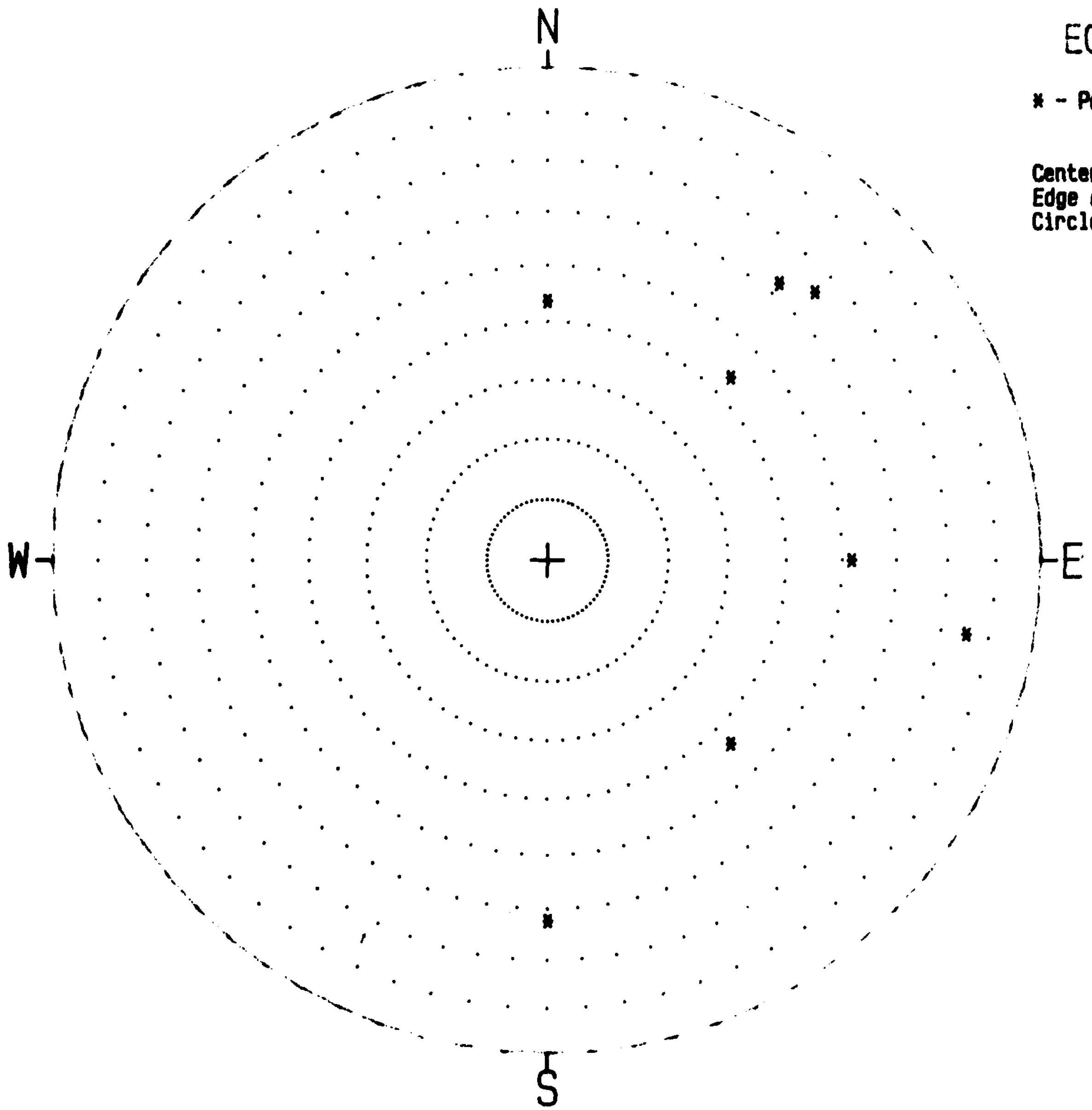
Drill Hole : BORING 19 Hole Size : HQ
Orientation : Vertical
Direction : 0 Hade : 0

Photographed and Interpreted by the
Southwest Division Lab

EQUAL AREA POLAR PLOT

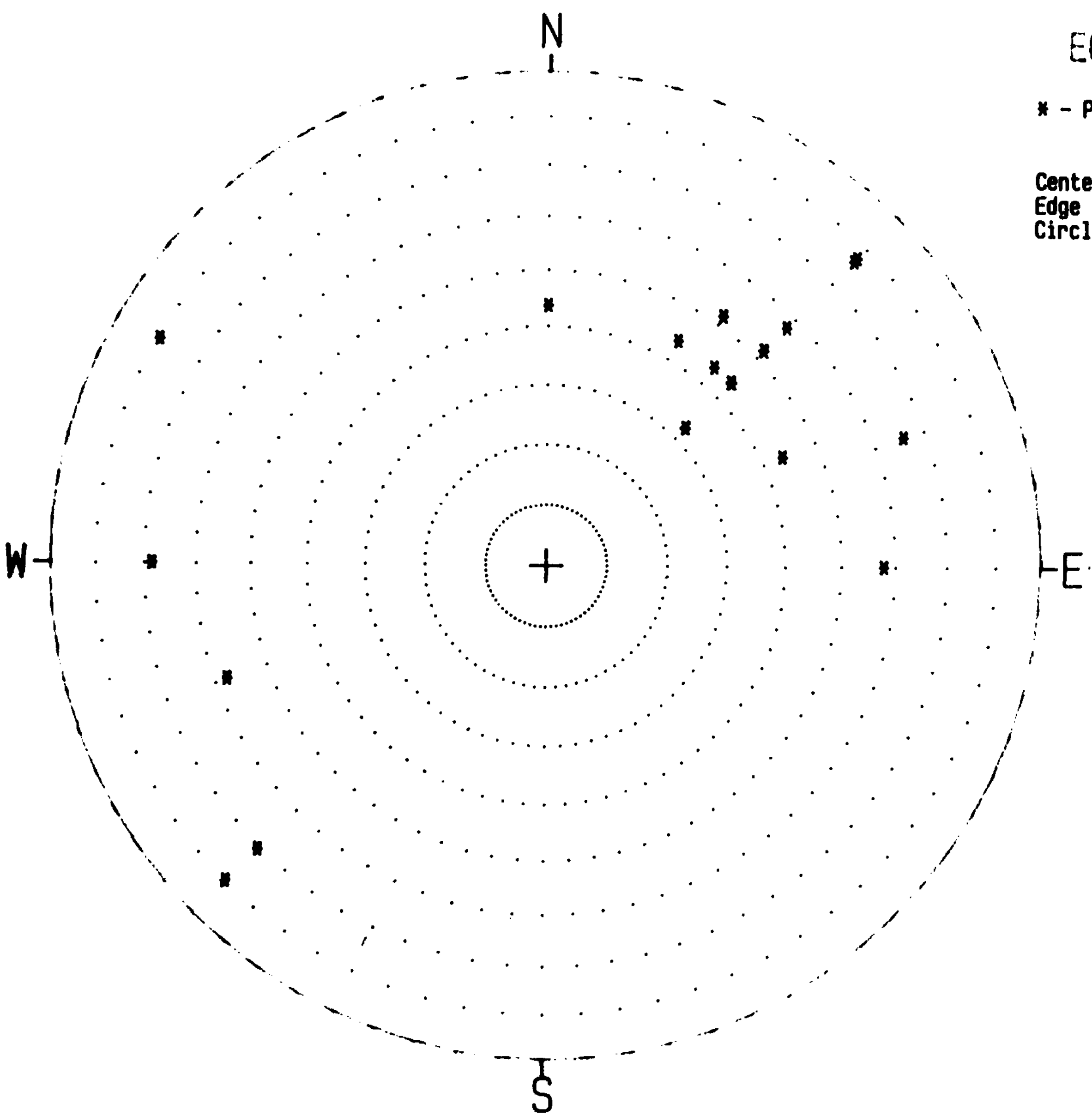
* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip



Project Name : CUCHILLO NEGRO DAM	
Drill Hole : BORING 20	Hole Size : HQ
Orientation : Vertical	
Direction : 0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	

EQUAL AREA POLAR PLOT



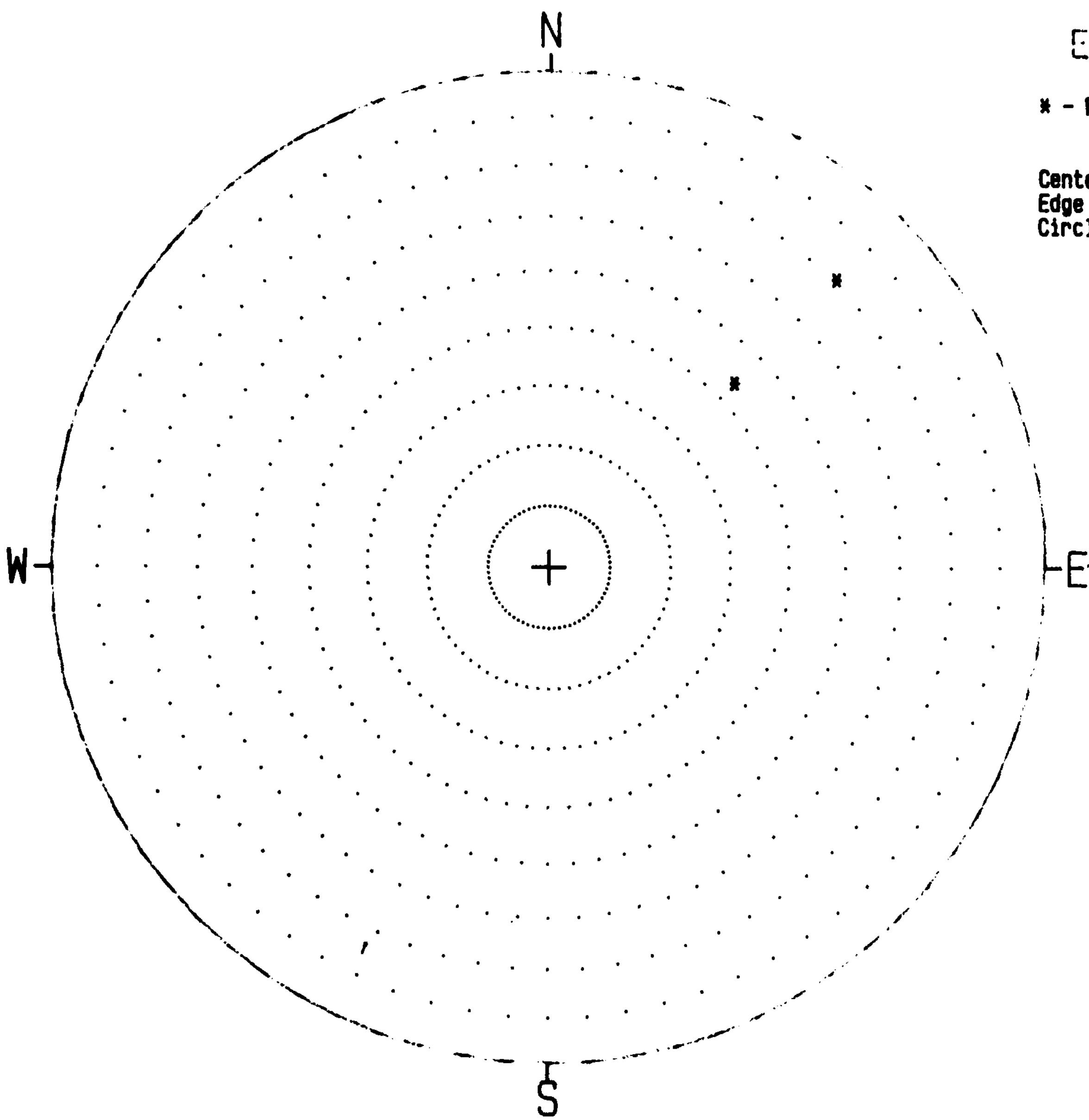
* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORING 21 Hole Size : HQ
Orientation : Vertical
Direction : 0 Hade : 0

Photographed and Interpreted by the Southwest Division Lab



EQUAL AREA POLAR PLOT

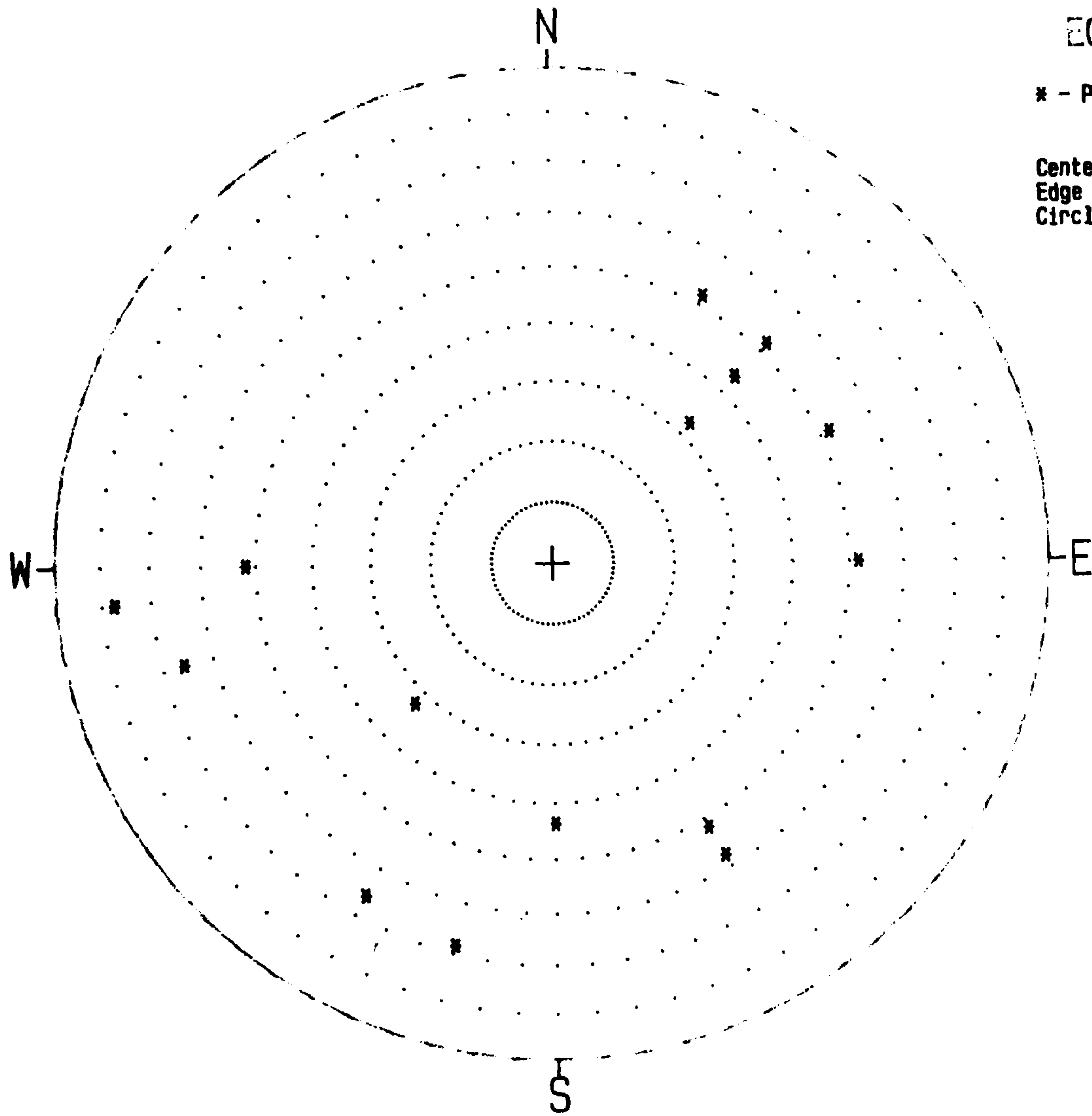
* - Pole representing dip direction
and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORING 22 Hole Size : HQ
Orientation : Vertical
Direction : 0 Hade : 0

Photographed and Interpreted by the
Southwest Division Lab

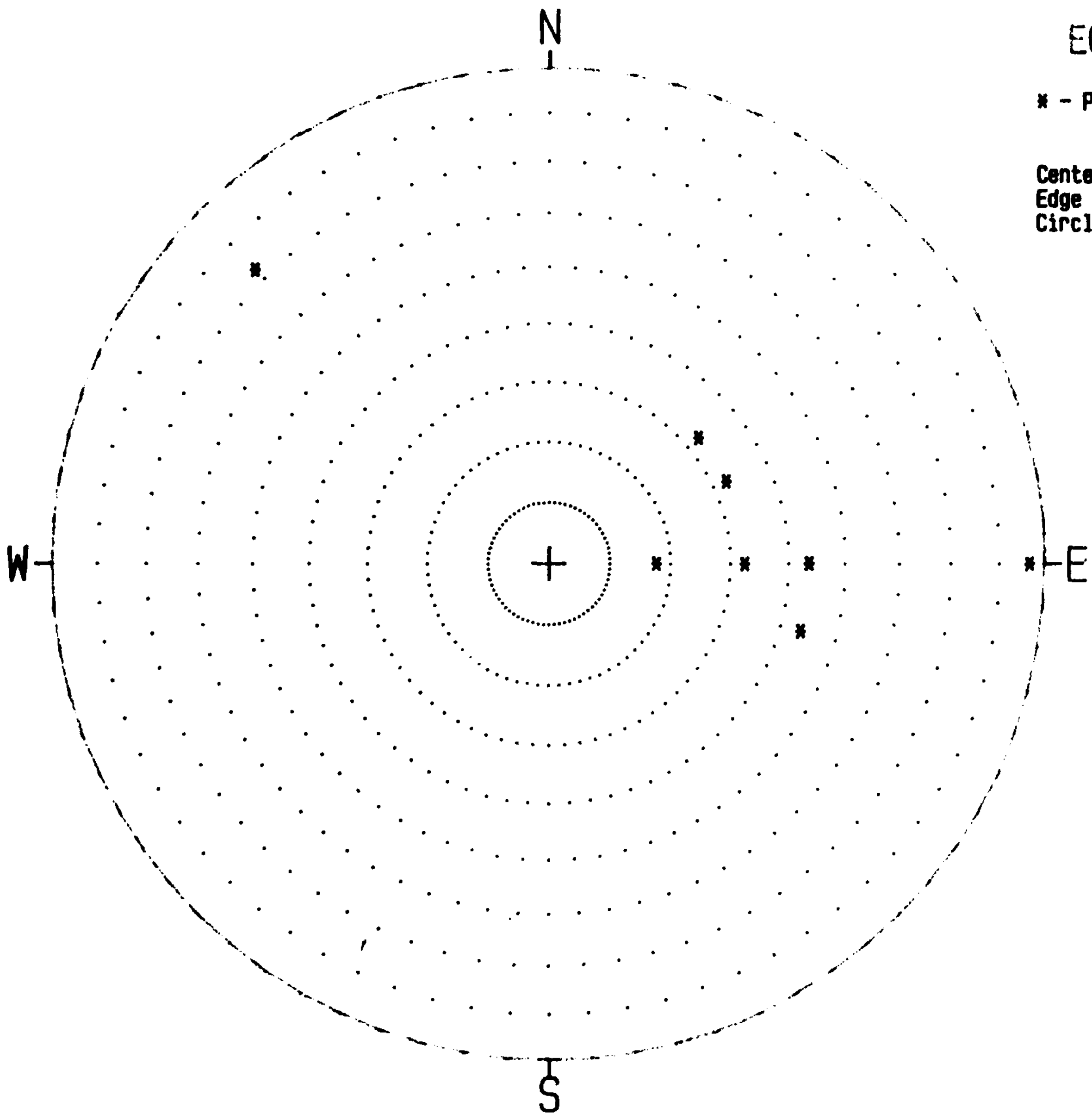


EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

Project Name : CUCHILLO NEGRO DAM	
Drill Hole : CH-23	Hole Size : HQ
Orientation : Vertical	
Direction : 0	Hade : 0
Photographed and Interpreted by the Southwest Division Lab	



EQUAL AREA POLAR PLOT

* - Pole representing dip direction and dip of planar features.

Center of plot equals 0 degrees dip
Edge of plot equals 90 degrees dip
Circles represent 10 degree increments of dip

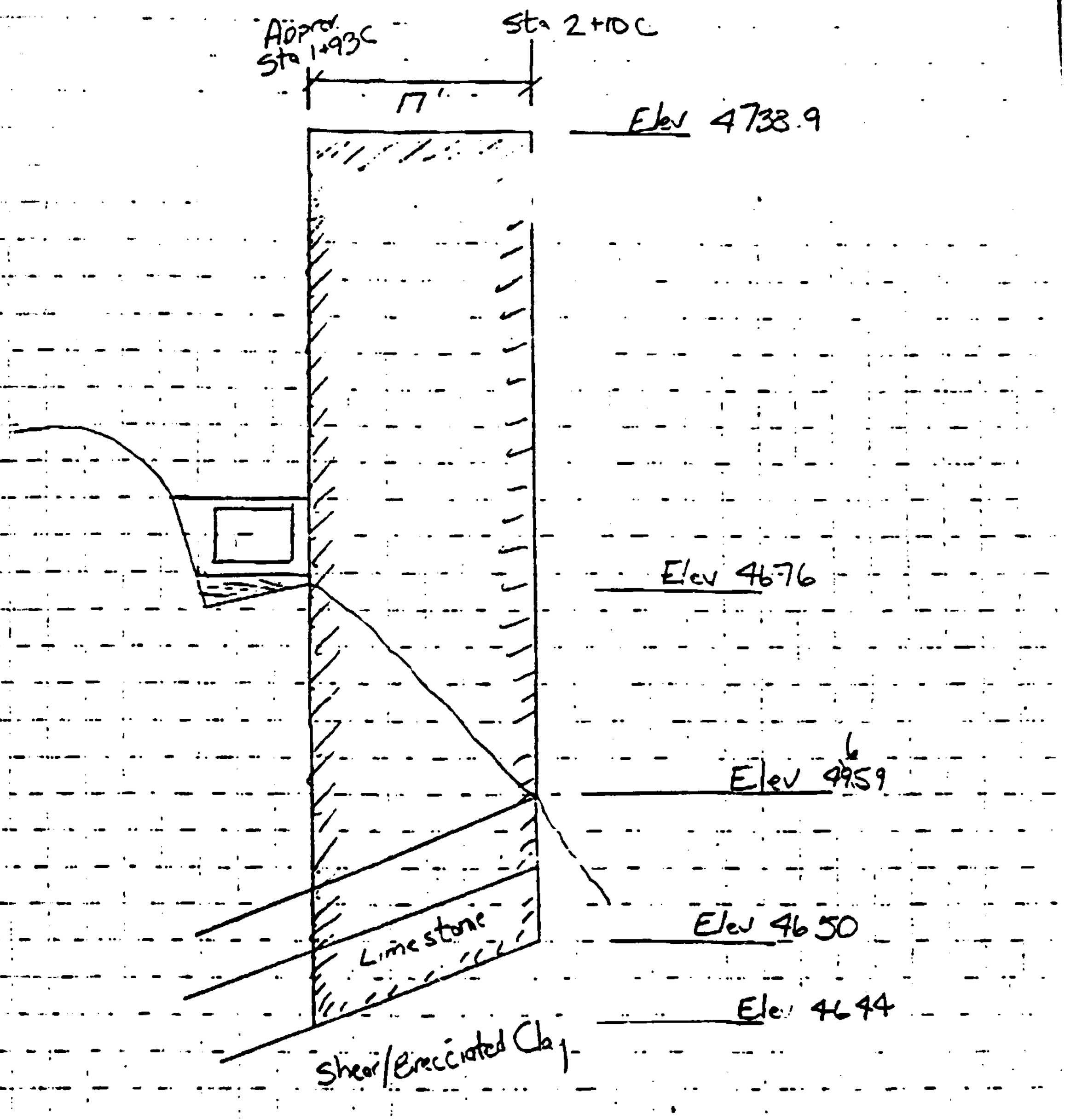
Project Name : CUCHILLO NEGRO DAM

Drill Hole : BORING 26 Hole Size : HQ
Orientation : Vertical
Direction : 0 Hade : 0

Photographed and Interpreted by the Southwest Division Lab

Stability Analysis on Left Abutment

Project Cuchillo Negro Dam
Job No. AL-C99-303-09
By BSP Date 3/9/91
Description Sliding Stability @ Brecciated Clay
SHEET 1 /



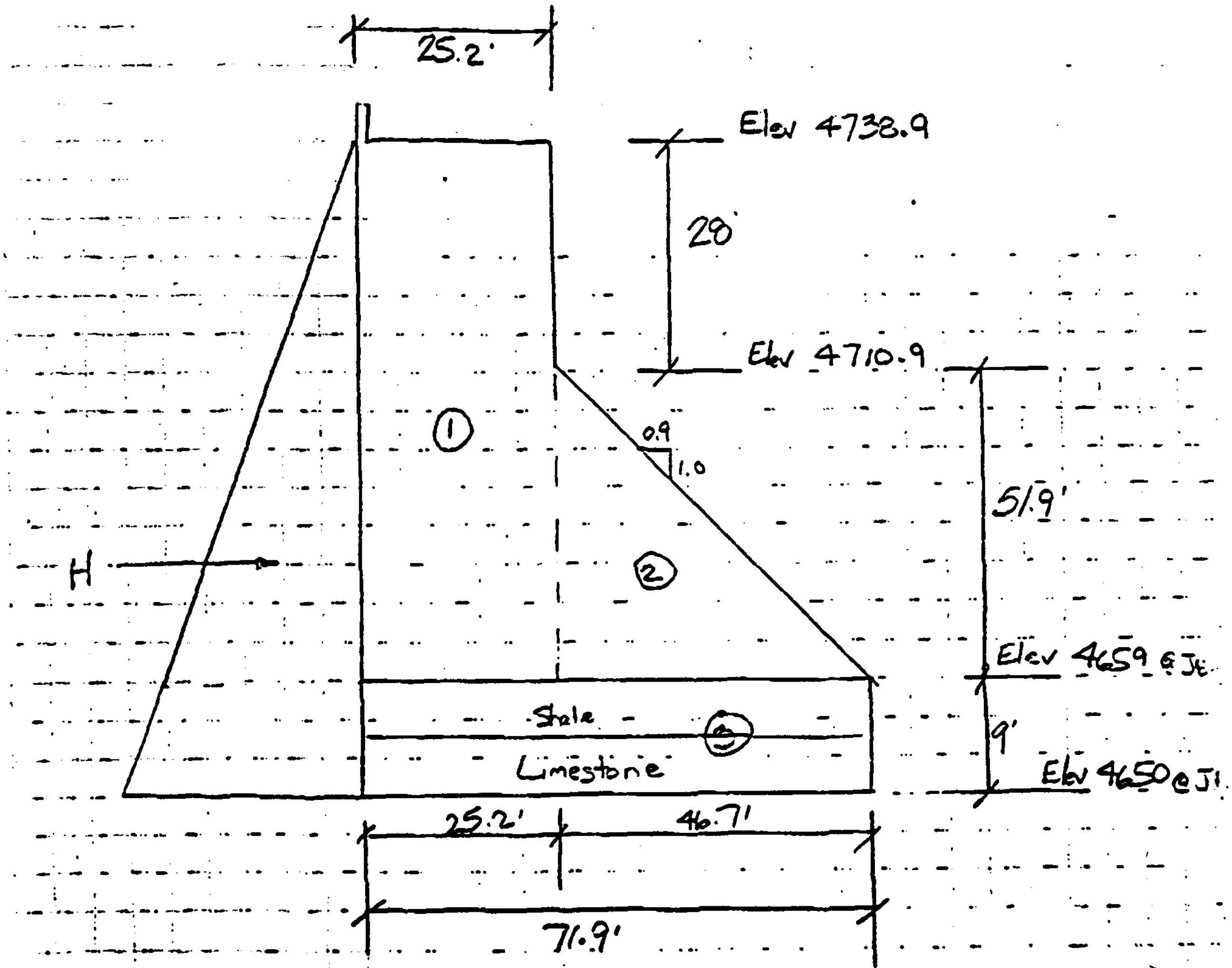
Design: Check Sliding Stability of shade section from Approx Sta 1+93 To Sta 2+10. Use φ angle of 11° @ Limestone / Brecciated Clay interface. Also Use C = 3KSF @ Vertical interface of Section @ Sta 1+93. Achieve F.S. = 2.0.
Use Load Case 16B: Gravity + Hydraulic + Uplift + Silt

BOYLE ENGINEERING CORPORATION

Project Cuchillo Negro Dam
Job No. AL-C99-303-09
By BSP Date 3/9/91

Description Sliding Stability @ Brecciated Clay Layer

SHEET 2 /



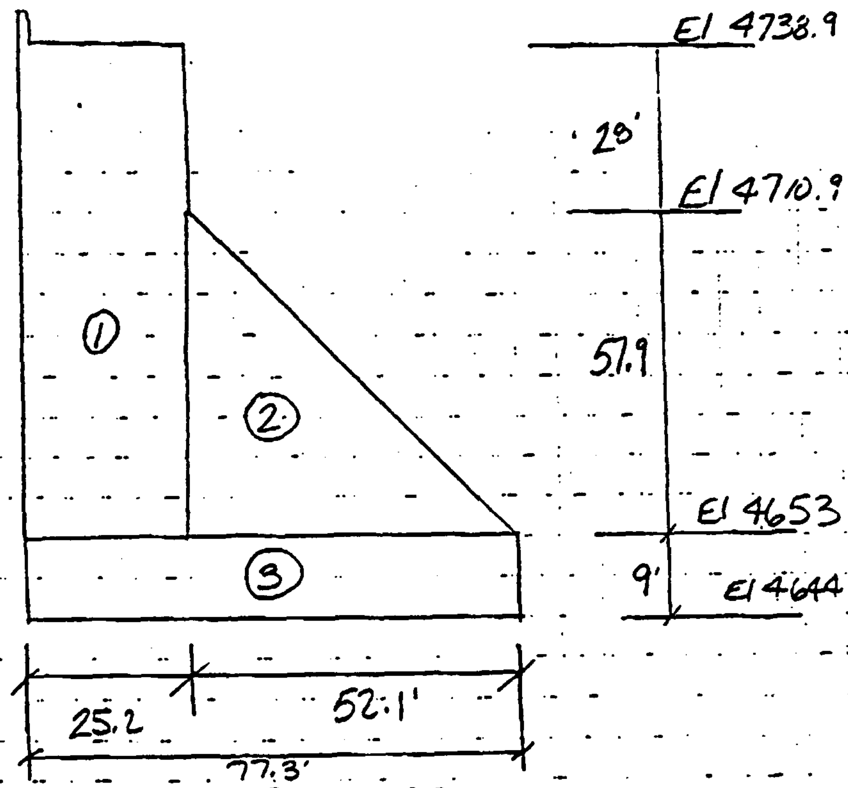
SECTION @ Sta 2+10

BOYLE ENGINEERING CORPORATION

Project Cuchillo Negro Dam
Job No. AL-C99-303-09
By RSP Date 3/9/91

Description Sliding Stability @ Brecciated Clay Layer

SHEET 2A/



SECTION @ STA 1+93

BOYLE ENGINEERING CORPORATION

Project: Cuchillo Negro Dam
Job No.: AL-C99-303-09
By: RSP Date: 3/9/91

Description: Sliding Stability @ Brecciated Clay

SHEET 3 /

GRAVITY LOADS

(1) $= \left[\frac{(25.2')(79.9') + (25.2')(85.9')}{2}\right](17')(0.150\,KCF) = 5327.2^k$

(2) $= \frac{1}{2}\left[\frac{1}{2}(51.9')(46.7') + \frac{1}{2}(52.1')(57.9')\right](17')(0.150\,KCF) = 3463.2^k$

(3) $= \frac{1}{2}\left[(9')(71.9') + (9')(77.3)\right](17')(0.150\,KCF) = 1712.1^k$

$\text{TOTAL } W_T = 10{,}507.5^k$

ΣM @ Upstream face $= (5327.2^k)\left(\frac{25.2}{2}\right) + (3463.2^k)\left(25.2' + \left(\frac{46.7/3 + 52/3}{2}\right)\right)$

$+ (1712.1^k)\left(\frac{71.9 + 77.3}{2(2)}\right) = 67{,}122.7 + 144{,}508 + 63{,}861.3$

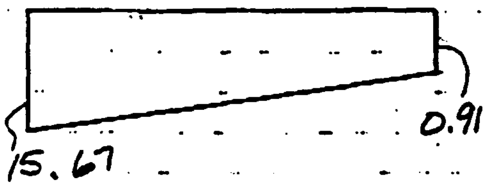
$= 275{,}492$ ft-k

Resultant Location $= \frac{275{,}492}{10{,}507.5}$ Avg length $= \frac{71.9 + 77.3}{2} = 74.6'$

$= 26.22'$ from upstream face

CONTACT PRESSURE $= \frac{10{,}507.5^k}{(17')(74.6')} \pm \frac{6(10{,}507.5)\left(\frac{74.6}{2} - 26.22'\right)}{(17')(74.6')^2}$

$= 8.29 \pm 7.38 = 15.67$ KSF @ Upstream & 0.91 KSF @ downstream



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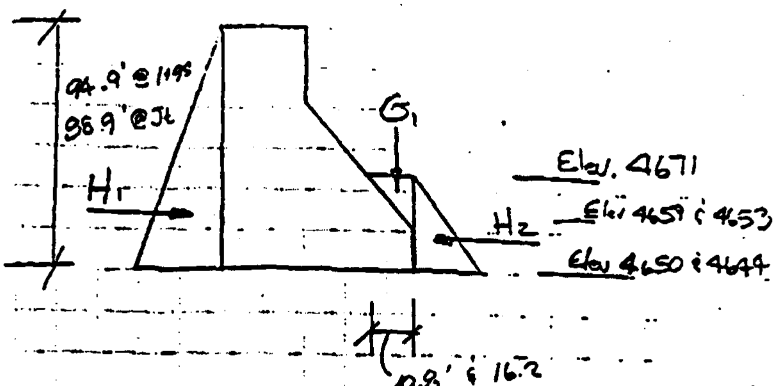
BOYLE ENGINEERING CORPORATION

Project: Cuchillo
Job No.: AI-C99-303-09
By: RSP   Date: 3/9/91
Description:
SHEET 4

Hydraulic Loads

Head Water @ 4733.9 & T.W. @ 4671



$$H_1 = \tfrac{1}{2}\left(\frac{94.9+88.9}{2}\right)^2 (0.0624\,\text{kcf})(17') = 4479.6^k$$

$$G_1 = \tfrac{1}{2}\left(\tfrac{1}{2}\right)\left[(10.8)(12)+(16.2)(18)\right](0.0624)(17') = 111.7^k$$

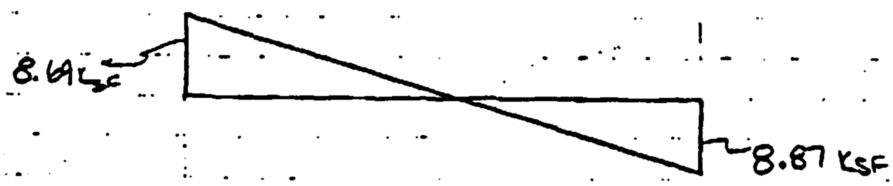
$$H_2 = \tfrac{1}{2}\left(\frac{21+27}{2}\right)^2(0.0624)(17') = 305.5^k$$

$$OTM_{@\,℄} = (4479.6^k)\left(\frac{94.9+88.9}{2(3)}\right) - 305.5^k\left(\frac{(21+27)/2}{3}\right) + 111.7^k\left(\frac{74.6}{2} - \frac{10.8+16.2}{2(3)}\right)$$

$$= 138{,}444.8\ \text{ft-k}$$

$$\text{Contact Pressure} = \frac{(111.7^k)}{(17')(74.6')} \pm \frac{6(138{,}444.8)}{(17')(74.6')^2} = 0.09 \pm 8.78$$

$$= 8.87\ \&\ -8.69$$



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BOYLE ENGINEERING CORPORATION

Project: Cuchillo Description: ______ SHEET 5 / ✓

Job No.: AL-C99-303-09

By: RSP Date: 3/9/91

Uplift Loads

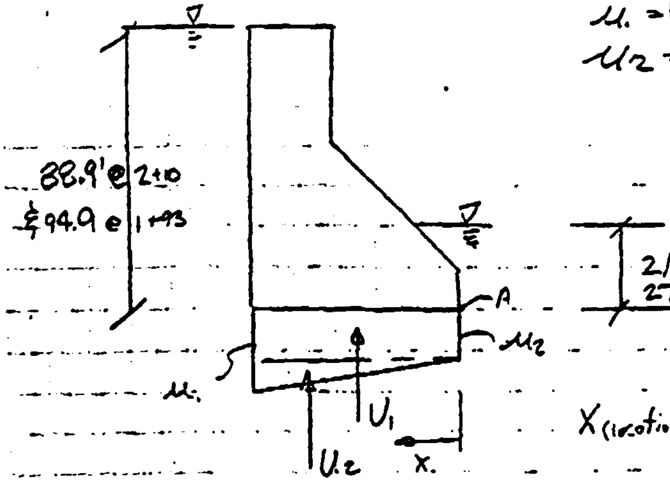
$u_1 = \left(\frac{88.9 + 94.9}{2}\right)(0.0624\,\text{KCF}) = 5.73\ \text{KSF}$

$u_2 = \left(\frac{21 + 27}{2}\right)(0.0624) = 1.50\ \text{KSF}$

$U_1 = (1.50\,\text{KSF})(74.6')(17') = 1902.3^{K}$

$U_2 = \frac{1}{2}(5.73 - 1.50)(74.6')(17') = 2682.2^{K}$

$\overline{4584.5^{K}}$



$OTM_A = (1902.3^{K})\left(\frac{74.6}{2}\right) + (2682.2^{K})(74.6)(2/3)$

$= 204,350.5^{ft\text{-}K}$

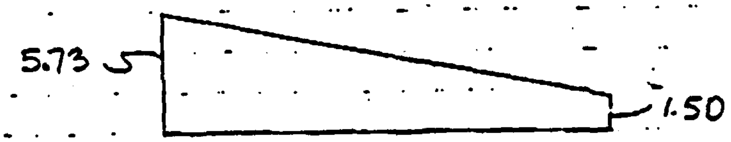
$X_{(\text{location of resultant})} = \frac{204,350.5}{4584.5} = 44.57'$

$e = 44.57 - \frac{74.6}{2} = 7.27'$ left of ℄

Contact Pressure $= \frac{-4584.5}{17(74.6')} \pm \frac{6(4584.5)(7.27')}{(17)(74.6)^2}$

$= -3.62 \pm 2.12 = -5.73\ \text{Ksf}$ @ Upstream

& $-1.50\ \text{Ksf}$ @ downstream



(Cont'd)

Project: Cochiti
Job No.: AL-C99-303-09
By: BSP
Date: 3/9/91
Description:
SHEET 6 /

Silt Load (To Elev 4601)

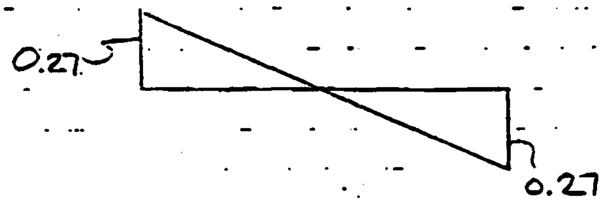
$\gamma_{moist} = 115\ pcf$

$$\text{Silt Load} = K_o(\gamma_{moist})\,h_{silt} = (0.33)(115pcf)\left(\frac{31.37}{2}\right)/1000 = 1.29\ ksf$$

$$\therefore R_1 = \tfrac{1}{2}(1.29ksf)(34')(17') = 372.9^k \rightarrow$$

$$\text{Contact Pressure} = \pm\frac{6(372.9^k)\left(\frac{34'}{3}\right)}{(17)(74.6)^2} = \pm 0.27\ ksf$$

(+ @ downstream
  − @ upstream)

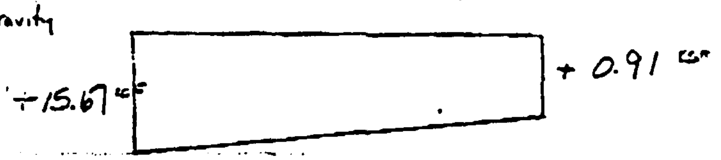


BOYLE ENGINEERING CORPORATION

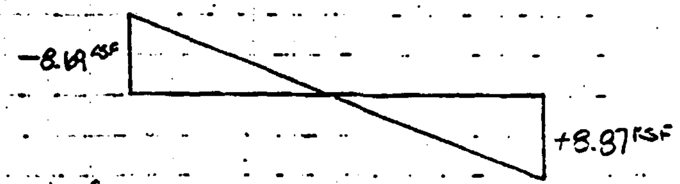
Project: Cuchillo
Job No.: AL-C99-303-09
By: RSP
Date: 3/9/91
Description:
SHEET 7 /

Combining Load Cases

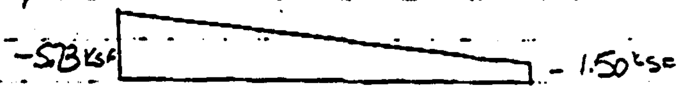
1) Gravity



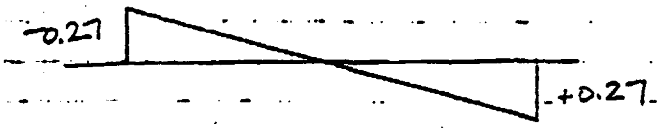
2) Hydraulic Load



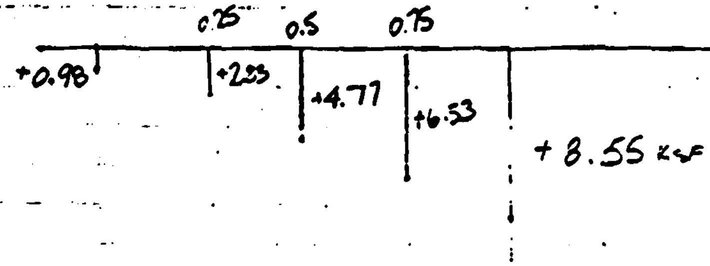
3) Uplift



4) Silt



Composite



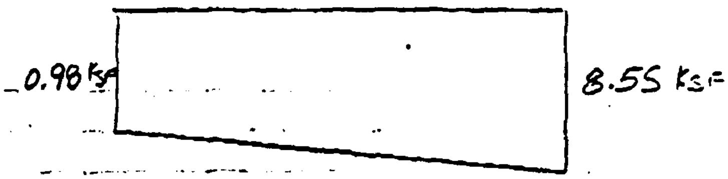
Try Straight line approximation for Straight line
@ 0.25 → 2.86
@ 0.50 → 4.71
@ 0.75 → 6.56
∴ Close enough to Straight line

BOYLE ENGINEERING CORPORATION

Project: Cuchillo
Job No.: AL-C99-303-09
By: BSP   Date: 8/9/91
Description:

SHEET 8 /

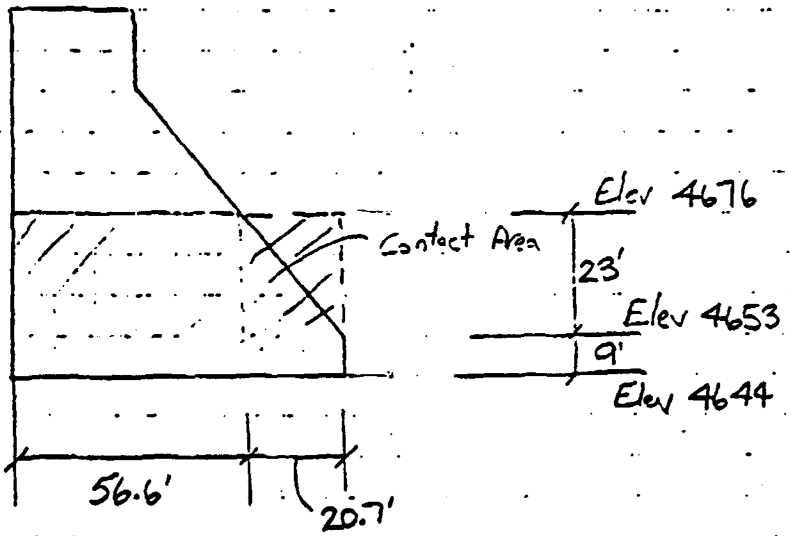
Contact Pressure Diagram



Total Contact Force $= \frac{1}{2}(0.98 + 8.55)(17')(74.6')$

$= 6{,}043^{k}$

Calculation Of Area @ Vertical Face For Cohesion



Contact Area $= (56.6' + 20.7')(32') = 2473.6$ S.F.

SLIDING STABILITY

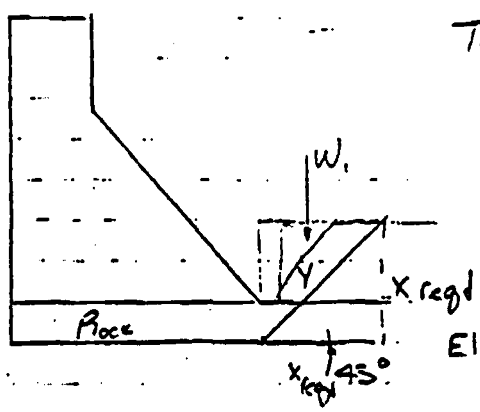
Total Horiz Force = $4479.6^k - 305.5^k - 572.9^k = 4547^k$

Required Resisting Force = $4547^k \times 2.0 = 9094^k$ (F.S)

- Resistance due to Internal ∡ of Friction = (Force) tan ϕ
$= (6043^k)(\tan 11°) = 1148^k$ Resistance

- Resistance due to cohesion @ Vertical Force
$= (2473.6\ S.F.)(3\ ksf)$
$= 7420^k$ Resistance

- Use passive block @ downstream face



Total Resistance ((Cohesion + Inter ∡))
$= 7420 + 1148 = 8568.8^k$
$F.S = \frac{8568.8 + x}{4547} = 2$
$\therefore X = 525.2^k$

Reqd Due to passive

$W_1 = \frac{1}{2}(X_{req})^2(17')(0.15\ kcf) = 525.2^k \rightarrow X_{reqd} = 20.3'$ ∴ OK

F.S. = 2

Water Pressure Test Results

03/17/92

CUCHILLO NEGRO DAMSITE
PRESSURE TEST SUMMARY

CORE HOLE	DEPTH (FEET)	PRESSURE (PSI)	WATER TAKE (CFM)	ELAPSED TIME (MINUTES)
CN-CH-09	8.0	7.0	1.50	11
CN-CH-09	50.0	19.0	1.47	12
CN-CH-10	23.0	17.0	1.49	11
CN-CH-10	58.0	17.0	1.49	11
CN-CH-11	12.0	8.0	1.11	11
CN-CH-11	25.0	19.0	1.53	12
CN-CH-11	50.0	14.0	1.48	11
CN-CH-12	6.0	6.0	1.73	11
CN-CH-12	20.0	12.0	1.75	11
CN-CH-12	50.0	15.0	1.70	11
CN-CH-15	34.1	14.0	1.33	10
CN-CH-15	73.8	32.0	0.25	10
CN-CH-16	33.0	19.0	0.83	10
CN-CH-16	53.0	33.0	0.80	10
CN-CH-16	54.1	23.0	1.18	10
CN-CH-16	73.0	36.0	0.11	10
CN-CH-17	48.3	26.0	5.88	10
CN-CH-17	59.7	36.0	0.74	10
CN-CH-17	64.7	38.0	0.32	10
CN-CH-18	16.5	10.0	0.86	10
CN-CH-18	24.4	15.0	0.13	10
CN-CH-18	33.4	19.0	0.03	10
CN-CH-18	43.4	24.0	0.40	10
CN-CH-18	73.4	37.0	0.29	10

CUCHILLO NEGRO DAMSITE
PRESSURE TEST SUMMARY

CORE HOLE	DEPTH (FEET)	PRESSURE (PSI)	WATER TAKE (CFM)	ELAPSED TIME (MINUTES)
CN-CH-19	32.5	19.0	6.23	10
CN-CH-19	48.5	28.0	6.28	10
CN-CH-19	58.5	28.0	3.66	10
CN-CH-19	73.5	32.0	3.77	10
CN-CH-20	30.0	0.0	3.87	10
CN-CH-20	52.5	0.0	23.0	10
CN-CH-21	43.6	19.0	22.0	10
CN-CH-21	70.5	36.0	3.45	10
CN-CH-21	93.8	43.0	4.25	10
CN-CH-21	117.5	54.0	3.69	10
CN-CH-22	43.8	22.0	1.84	10
CN-CH-22	73.5	35.0	1.87	10
CN-CH-22	87.5	46.0	0.94	10
CN-CH-23	37.0	0.0	4.41	10
CN-CH-23	62.0	0.0	4.32	10
CN-CH-23	82.0	15.0	0.70	10
CN-CH-25	13.0	1.0	5.25	8
CN-CH-25	20.0	3.0	4.71	10
CN-CH-25	40.0	5.0	3.98	10
CN-CH-25	60.0	15.0	0.94	10
CN-CH-26	14	10	1.19	15
CN-CH-26	30	20	3.14	15
CN-CH-26	58	19	4.3	15
CN-CH-27	19	12	0.51	15

CUCHILLO NEGRO DAMSITE
PRESSURE TEST SUMMARY

CORE HOLE	DEPTH (FEET)	PRESSURE (PSI)	WATER TAKE (CFM)	ELAPSED TIME (MINUTES)
CN-CH-27	34	22	1.12	16
CN-CH-28	27	20	0.91	15
CN-CH-28	5.5	5	0.21	15
CN-CH-28	51	32	1.19	20
CN-CH-29	23	19	3.55	12
CN-CH-29	50	35	4.79	18
CN-CH-29	92	28	5.3	20
CN-CH-30	45	35	1.93	15
CN-CH-30	8	5	0.33	10
CN-CH-30	91	40	2.30	20
CN-CH-31	30	25	0.90	15
CN-CH-31	9	5	0.71	15
CN-CH-31	95	45	0.30	22
CN-CH-32	11	8	1.30	15
CN-CH-32	31	20	0.91	20
CN-CH-32	75	50	1.13	20

APPENDIX F

APPENDIX F

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Contractor's Dewatering Plan	F-14
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Government's Directive to Remove Differing Site Condition Material	F-35
Contractor's Wire Mesh Installation Plan	F-41
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Contractor's Excavation Plan

Rc'd 31 Nov 89

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

November 30, 1989

Serial Letter No.: 050/02219/1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Excavation Plan

Gentlemen:

Pursuant to Technical Provision 02219, Paragraph 1, four (4) copies of PCL Civil Constructors Excavation Plan are herewith transmitted to the contracting officer for review.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

PCL CIVIL CONSTRUCTORS, INC.

EXCAVATION PLAN
FOR
RIO GRANDE FLOODWAY
CUCHILLO DAM
CONTRACT NO: DACW47-89-C-0056

1. Common Excavation:

During the common excavation phase of the project, PCL Civil Constructors will utilize the following equipment to perform the required excavation:

2 - D-8K Dozer
2 - D-9H Dozer
4 - Cat 631C Scraper
1 - 4500 Gallon Water Truck

Other support equipment may be added to the above if warranted by field conditions. PCL Civil Constructors Material Utilization and Flow Diagram for common excavation is represented on the attached drawings EX-1 and EX-2

2. Rock Excavation:

Drilling and blasting for the required rock excavation will be performed by the following subcontractor:

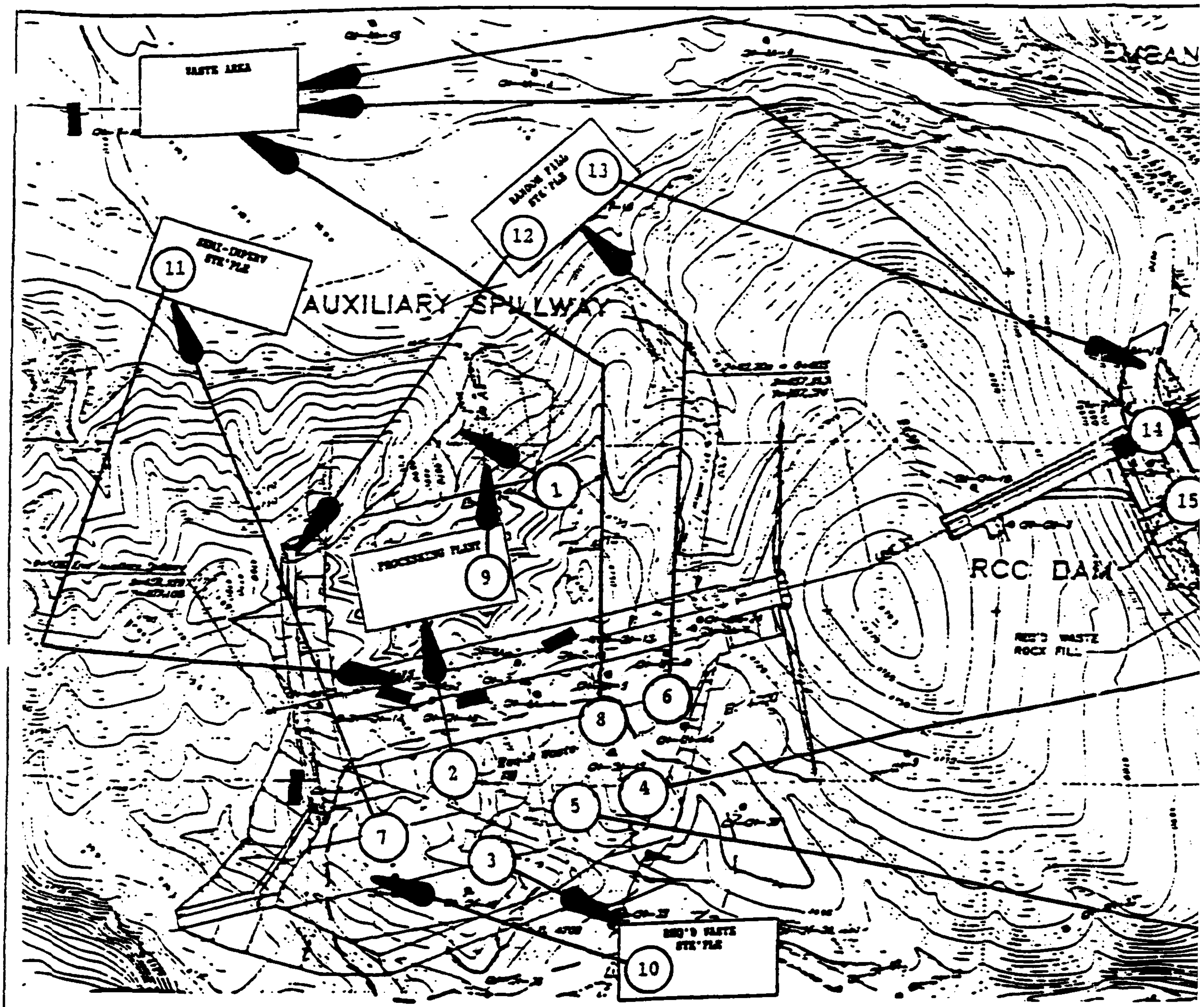
McCaw's Drilling (USA), Inc,
1645 Court Place, Suite 315
Denver, Colorado, 80202

McCaw's Drilling (USA), Inc. will have competent and experienced personnel familiar with all aspects of blasting on the project site. Explosive products will be supplied by Ireco, Incorporated and the Ensign - Bickford Company. A formal submittal of our blasting operations will be made under Technical Provision 02219, Paragraph 7, titled "Blasting", prior to the start of this work.

Removal of shot rock will be performed according to the Material Utilization and Flow Diagram for rock excavation which is represented on attached drawings EX-3 and EX-4. PCL Civil Constructors will utilize the following equipment in the removal of shot rock:

1 - Cat 988B Loader
1 - Cat 245 Excavator
4 - Cat 769 Off-Highway End Dumps (35T)

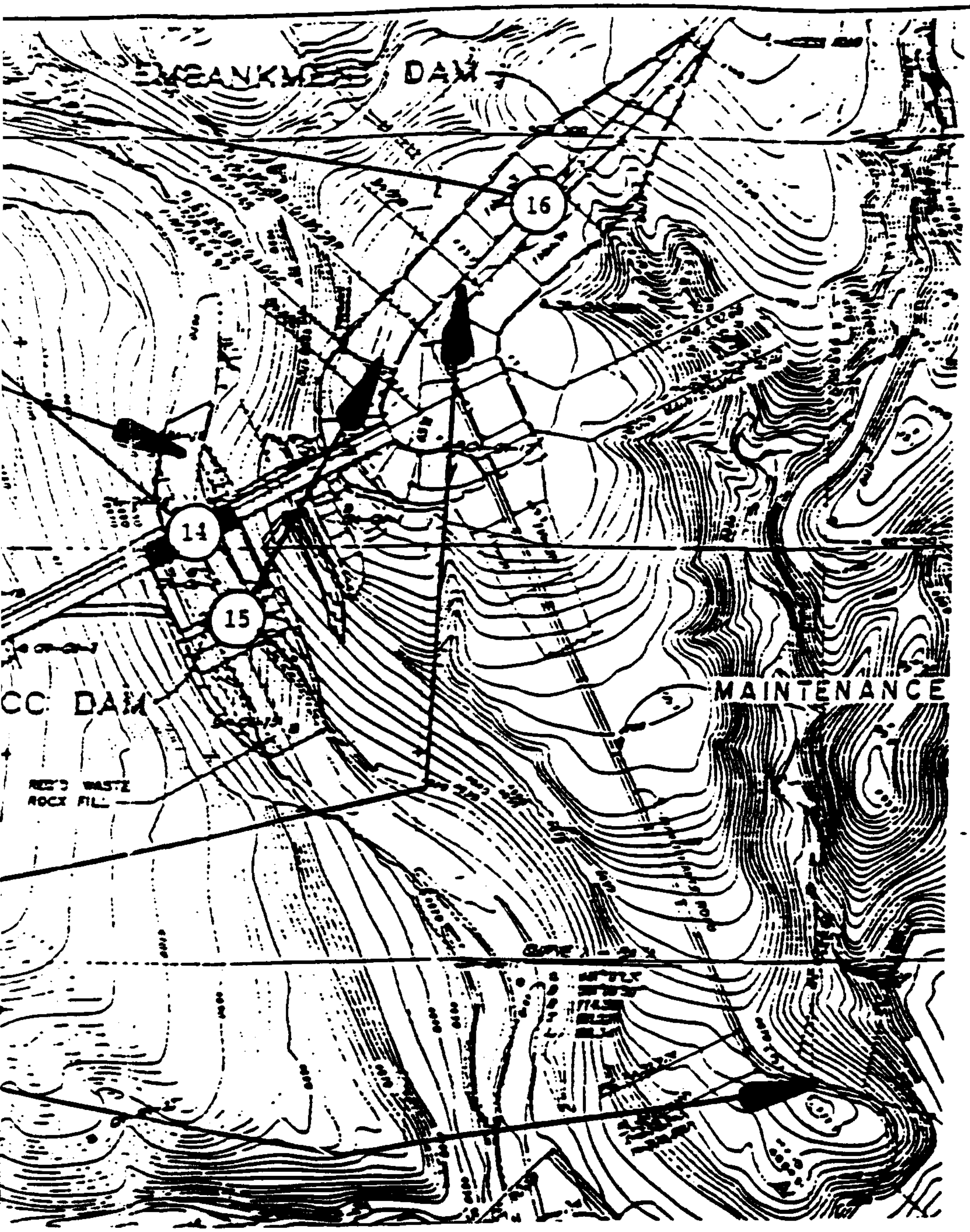
Other support equipment may be added to the above if warranted by field conditions.



NOTE: SEE DWG EX-2 FOR LABELS & QUANTITIES FOR ARROWS

PROCESSED MATERIAL SUMMARY
(CRUSHER QUANTITIES)

BID ITEM	DESCRIPTION	PCL NEAT QTY (BCY)	PLACEMENT & STOCKPILE LOSS: FACTOR	PLACEMENT & STOCKPILE LOSS: LOSS QTY (CY)	STOCKPILE QTY (CY)	CRUSHER WASTE: FACTOR	CRUSHER WASTE: WASTE QTY (CY)	HAUL [illegible] QTY TO CRUSHER (BCY)
6	FILTER MATERIAL	4,300	0.25	1,200	6,300	0.20	1,300	7,3[illegible]
7	GRAVEL SURFACING	7,900	0.25	1,975	9,375	0.10	[illegible]	10,5[illegible]
10	BEDDING SAND	1,900	0.20	380	2,280	0.10	[illegible]	2,59[illegible]
20	RCC DAM AGGREGATE	N/A	N/A	N/A	79,200	0.15	11,880	91,0[illegible]
21	RCC SPILLWAY AGGREGATE	N/A	N/A	N/A	34,900	0.15	5,235	[illegible]
	TOTALS				132,155		28,535	152,[illegible]



RANDOM FILL
BID ITEM NO. 6
BID QTY = [illegible] CY

LOCATION	PCL NEAT QTY (ECY)	SHRINK FACTOR	BANK QTY (BCY)
EMBANKMENT DAM	[illegible]	1.15	[illegible]
RCC DAM BACKFILL	[illegible]	1.15	[illegible]
SPILLWAY BACKFILL	1,500	1.15	1,840
MAINTENANCE ROAD	[illegible]	1.15	37,605
TOTALS	58,500		78,775

SEMI-IMPERVIOUS FILL
BID ITEM NO. 5
BID QTY = [illegible] CY

LOCATION	PCL NEAT QTY (ECY)	SHRINK FACTOR	BANK QTY (BCY)
EMBANKMENT DAM	19,340	1.20	[illegible]
SPILLWAY BACKFILL	2,420	1.20	2,904
TOTALS	[illegible]		26,112

REQUIRED WASTE FILL
BID ITEM NO. 27
BID QTY = 174,300 CY

LOCATION	PCL NEAT QTY (ECY)	SHRINK FACTOR	BANK QTY (BCY)
NORTH SPILLWAY	48,580	1.05	51,009
SOUTH SPILLWAY	[illegible]	1.05	[illegible]
TOTALS	168,980		177,429

STOCKPILE QTY (CY)	CRUSHER WASTE FACTOR	CRUSHER WASTE WASTE QTY (CY)	HAUL IN QTY TO CRUSHER (BCY)
6,300	0.10	1,300	7,800
9,375	0.10	988	10,363
2,160	0.20	432	2,592
79,200	0.15	11,880	91,080
36,300	0.15	5,225	[illegible]
132,125		20,535	152,670

COMMON EXCAVATION SUMMARY
BID ITEM NO. 2
BID QTY = 589,300 CY

LOCATION	PCL BANK QTY (BCY)
RCC DAM AREA	32,536
STRIPPING @ EMBANKMENT DAM	7,560
INSPECTION TRENCH @ EMBANKMENT DAM	7,123
SPILLWAY - LINE 5	492,143
TOTALS	540,362

PCL CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCHILLO DAM)

Common Excavation
Material Flow
Diagram

11-22-89

EX-1

PCL CIVIL CONSTRUCTORS
COMMON EXCVATION FLOW CHART SUMMARY
BID ITEM NO. 2

LABEL NO	DESCRIPTION	BID NO.	FROM	BID NO.	
1	SPILLWAY EXCAV TO SPILLWAY NORTH REQ'D WASTE FILL	2	SPILLWAY	37	S
2	SPILLWAY EXCAV TO PROCESSING PLANT (CRUSHER)	2	SPILLWAY	NP	P
3	SPILLWAY EXCAV TO REQ'D WASTE STOCKPILE	2	SPILLWAY	NP	S
4	SPILLWAY EXCAV TO EMBANKMENT DAM SEMI-IMPERV FILL	2	SPILLWAY	5	E
5	SPILLWAY EXCAV TO MAINTENANCE ROAD RANDOM FILL	2	SPILLWAY	4	M
6	SPILLWAY EXCAV TO RANDOM FILL STOCKPILE	2	SPILLWAY	NP	S
7	SPILLWAY EXCAV TO SEMI-IMPERV STOCKPILE	2	SPILLWAY	NP	S
8	SPILLWAY EXCAV TO WASTE AREA	2	SPILLWAY	NP	W
9	PROCESSING PLANT WASTE TO SPILLWAY NORTH REQ'D WASTE FILL	NP	PROCESS PLT	37	S
10	REQ'D WASTE STOCKPILE TO SPILLWAY SOUTH REQ'D WASTE FILL	NP	STOCKPILE	37	S
11	SEMI-IMPERV STOCKPILE TO SPILLWAY BACKFILL	NP	STOCKPILE	5	S
12	RANDOM FILL STOCKPILE TO SPILLWAY RIGHT ABUTMENT FILL	NP	STOCKPILE	4	S
13	RANDOM FILL STOCKPILE TO RCC DAM NORTH FILL	NP	STOCKPILE	4	R
14	RCC DAM EXCAVATION TO WASTE AREA	2	RCC DAM	NP	W
15	RCC DAM EXCAVATION TO EMBANKMENT DAM RANDOM FILL	2	RCC DAM	4	E
16	EMBANKMENT DAM STRIPPING & INSPEC TRENCH TO WASTE AREA	2	EMB DAM	NP	W
	TOTALS:				

COMMON
REH.

AVERAGE HAUL FOR CO

FROM	BID NO.	TO	QUANTITY (BCY)	HAUL DISTANCE (FT)	BCY-FT
SPILLWAY	37	SPILLWAY	30,674	200	6134800
SPILLWAY	NP	PROCESS PLT	152,470	400	60988000
SPILLWAY	NP	STOCKPILE	126,420	350	44247000
SPILLWAY	5	EMB DAM	23,208	2900	67303200
SPILLWAY	4	MAINT RD	37,605	1700	63928500
SPILLWAY	NP	STOCKPILE	11,270	1100	12397000
SPILLWAY	NP	STOCKPILE	2,904	1050	3049200
SPILLWAY	NP	WASTE	107,592	1300	139869600
PROCESS PLT	37	SPILLWAY	20,335	200	4067000
STOCKPILE	37	SPILLWAY	126,420	350	44247000
STOCKPILE	5	SPILLWAY	2,904	650	1887600
STOCKPILE	4	SPILLWAY	1,840	700	1288000
STOCKPILE	4	RCC DAM	9,430	1150	10844500
RCC DAM	NP	WASTE AREA	3,636	1850	6726600
RCC DAM	4	EMB DAM	29,900	1400	41860000
EMB DAM	NP	WASTE	14,683	1900	27897700
			701,291		536,735,700

COMMON EXCAV = 540,362
REHANDLE = 160,929

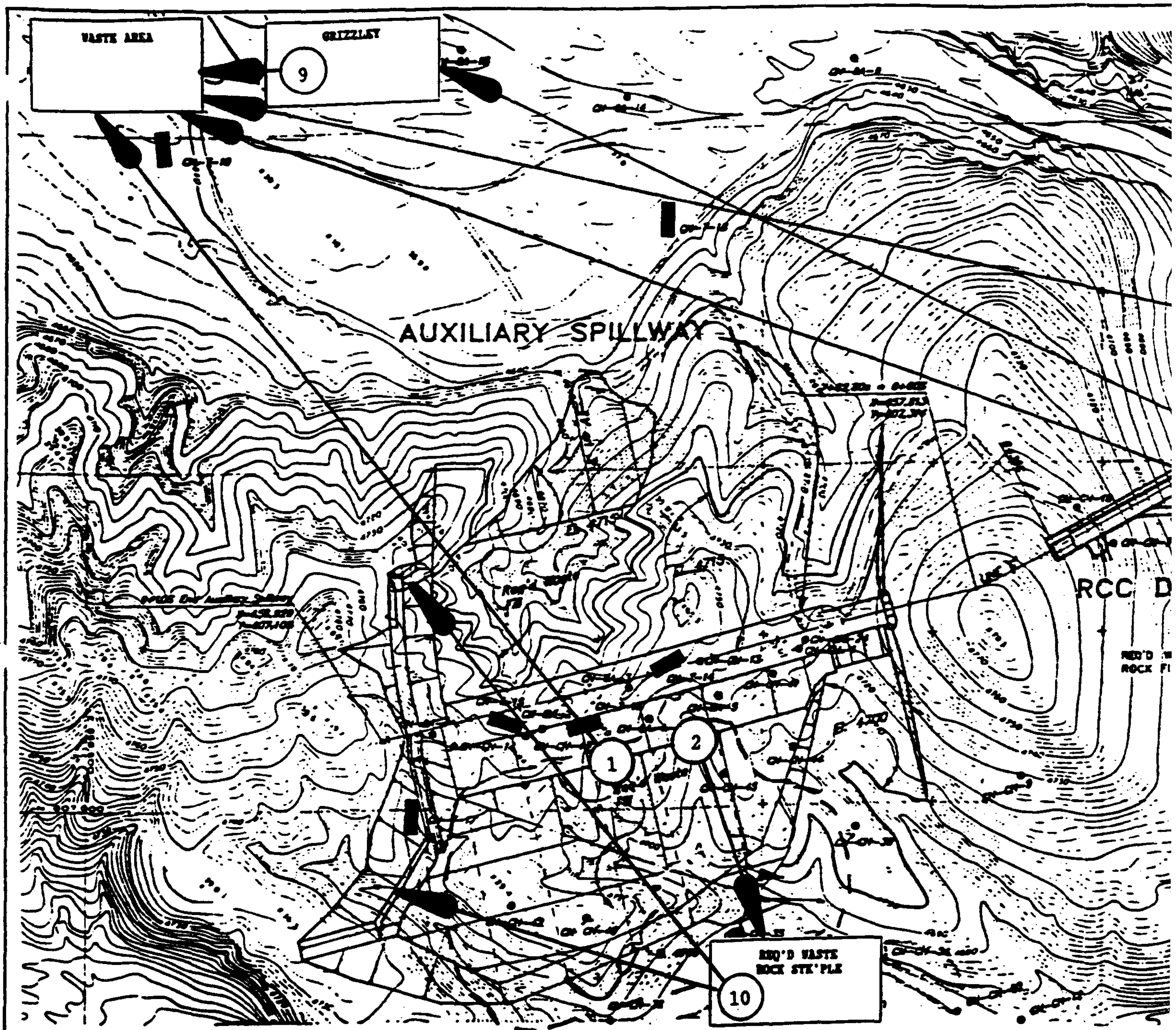
AVERAGE HAUL FOR COMMON EXCAVATION (FT): 765.4 FT

P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCHILLO DAM)

Common Excavation Material Flow Diagram Summary

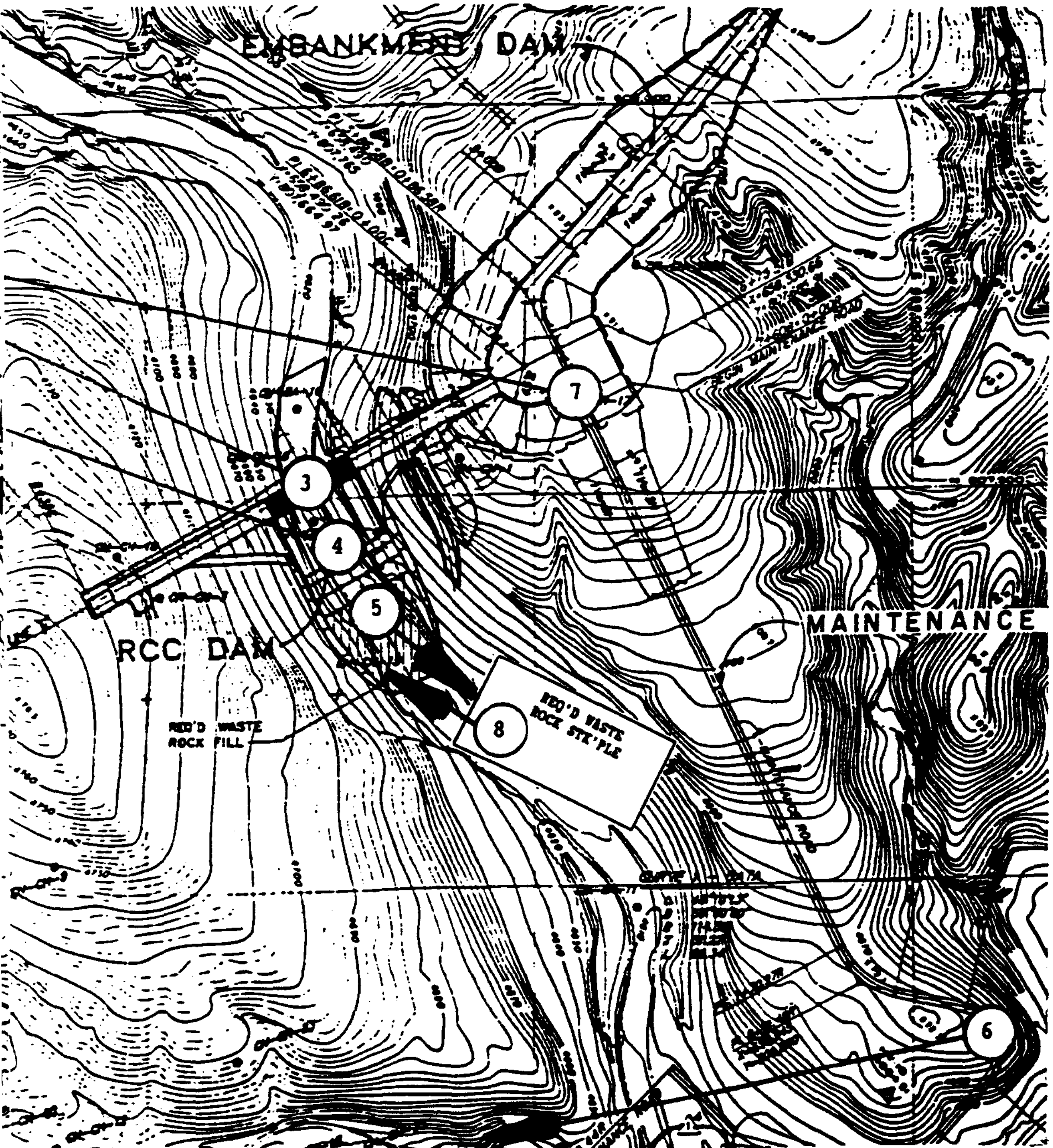
EX-2



PROCESSED MATERIAL SUMMARY
(GRIZZLEY QUANTITIES)

BID ITEM	DESCRIPTION	PCL NEAT QTY (BCY)	PLACEMENT & STOCKPILE LOS FACTOR	LOSS QTY (CY)
8	DUMPED ROCK - 12"	1,700	0.25	[illegible]
9	DUMPED ROCK - 18"	2,800	0.25	[illegible]
	TOTALS			

NOTE: SEE DWG EX-4 FOR LABELS & QUANTITIES FOR ARROWS



REQUIRED WASTE ROCK FILL
BID ITEM NO. 16
BID QTY = 3,400 CY

LOCATION	PCL NEAT QTY (ECY)	SHRINK FACTOR	BANK QTY (BCY)
RCC DAM BACKFILL	6,983	1.00	6,983
SPILLWAY BACKFILL	1,358	1.00	1,358
TOTALS	8,341		8,341

ROCK EXCAVATION SUMMARY
BID ITEM NO. 3
BID QTY = 60,300 CY

LOCATION	PCL BANK QTY (BCY)
RCC DAM AREA	34,532
SPILLWAY - LINE 3	27,399
MAINTENANCE ROAD	2,216
INSPECTION TRENCH & EMBANKMENT DAM	220
TOTALS	64,365

NOTE: RCC DAM ROCK QUANTITIES INCLUDE BOTH OUTLET WORKS.

MARY

LOCATION	PCL NEAT QTY (ECY)	PLACEMENT & STOCKPILE LOSS: FACTOR	PLACEMENT & STOCKPILE LOSS: LOSS QTY (CY)	STOCKPILE QTY (CY)	GRIZZLEY WASTE: FACTOR	GRIZZLEY WASTE: WASTE QTY (CY)	HAUL IN QTY TO GRIZZLEY (BCY)
[illegible]	1,700	0.25	425	2,125	1.30	528	2,763
[illegible]	1,300	0.25	700	1,500	1.22	1,390	4,390
				3,625		1,688	7,313

P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCHILLO DAM)

Rock excavation material flow diagram

EX-3

PCL CIVIL CONSTRUCTORS
ROCK EXCVATION FLOW CHART SUMMARY
BID ITEM NO. 3

LABEL NO	DESCRIPTION	BID NO.	FROM	BID NO.	TO
1	SPILLWAY EXCAV TO WASTE AREA	3	SPILLWAY	NP	WASTE
2	SPILLWAY EXCAV TO REQ'D ROCK WASTE STOCKPILE	3	SPILLWAY	NP	STOCKPI
3	RCC DAM EXCAV TO WASTE AREA	3	RCC DAM	NP	WASTE
4	RCC DAM EXCAV TO GRIZZLEY (PROCESSING PLANT)	3	RCC DAM	NP	GRIZZLE
5	RCC DAM EXCAV REQ'D ROCK WASTE STOCKPILE	3	RCC DAM	NP	STOCKPI
6	MAINTENANCE ROAD EXCAV TO WASTE AREA	3	MAINT RD	NP	HAUL RO
7	EMBANKMENT DAM INSPEC TRENCH TO WASTE AREA	3	EMB DAM	NP	WASTE
8	REQ'D ROCK WASTE STOCKPILE TO RCC DAM BACKFILL	NP	STOCKPILE	36	RCC DAM
9	GRIZZLEY PLANT WASTE TO WASTE AREA	NP	GRIZZLEY	NP	WASTE
10	REQ'D ROCK WASTE STOCKPILE TO SPILLWAY BACKFILL	NP	STOCKPILE	36	SPILLWA

TOTALS:

ROCK EXCAV =
REHANDLE =

AVERAGE HAUL FOR ROCK EXC

FROM	BID NO.	TO	QUANTITY (BCY)	HAUL DISTANCE (FT)	BCY-FT
LLWAY	NP	WASTE	26,541	1300	34503300
LLWAY	NP	STOCKPILE	1,358	600	814800
DAM	NP	WASTE	20,236	1850	37436600
DAM	NP	GRIZZLEY	7,313	1850	13529050
DAM	NP	STOCKPILE	6,983	450	3142350
NT RD	NP	HAUL ROADS	2,314	600	1388400
DAM	NP	WASTE	220	1900	418000
CKPILE	36	RCC DAM	6,983	450	3142350
ZZLEY	NP	WASTE	1,688	0	0
CKPILE	36	SPILLWAY	1,358	600	814800
			74,994		95,189,650

ROCK EXCAV = 64,965
REHANDLE = 10,029

RAGE HAUL FOR ROCK EXCAVATION (FT): 1269.3 FT

P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY ([illegible] DAM)

Rock excavation material flow diagram summary

11-22-89

EX-4

Contractor's RCC Foundation Preparation Plan

PCL

PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

January 15, 1990

Serial Letter No.: 121/03360/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Roller Compacted Concrete Foundation Preparation & Joint Treatment Plan, Amendment No. 1

Gentlemen:

Reference is made to your Serial Letter No. 42/03360/10.1 and PCL Civil Constructor's Serial Letter No. 89/03360/10.1, all pertaining to the afore said subject matter. This letter and the information contained herein will serve as Amendment No. 1 to PCL Civil Constructor's Roller Compacted Concrete Foundation Preparation and Joint Treatment Plan.

1. The following is hereby added under Paragraph IB:

   "Low pressure water jets will have 1-inch nozzles"

2. PCL Civil Constructors acknowledges and accepts your statement regarding the truck mounted vacuum pickup system as being a contractual requirement. Hence, during the foundation clean-up, the specified model 2045 vactor or equal will be on the project site.

3. The following is hereby added under Paragraph II:

   "The bedding mix will be covered with the designated RCC mix within 15 minutes after placement of the bedding mix."

P.O. Box 2270, Truth or Consequences, N.M. 87901 Telephone 505-743-7834 Rapidfax 505-743-7836

Mr. Wiley S. Isom
RE: RCC Foundation Preparation &
Joint Treatment Plan, Amendment No. 1
January 15, 1990
Page Two of Two

4. The following is hereby added under Paragraph II:

"Vertical Cold Joints:

When it becomes apparent that placement of RCC will be terminated before the entire lift has been completed across the surface area, the RCC edge shall be flattened to a tapered slope no steeper than 3 horizontal on 1 vertical. The tapered edge shall be compacted with the vibratory rollers to the required density. These joints shall be treated as Type I or Type II cold joints and bedding mix applied accordingly. Such occurrences are likely when a breakdown of equipment takes place or when a shutdown is necessary due to climatic factors."

5. The continuous clock temperature recording devices will be furnished by our material testing subcontractor, Western Technologies. Descriptive literature on the type of recorders will be forwarded to the Contracting Officer no later than February 15, 1990. The recorders will be placed where directed or approved and all records will be turned in with the Quality Control Reports.

I trust the information presented above will satisfy the Contracting Officers remaining concerns regarding foundation preparation and joint treatment and lead to an expedient approval of our plan. Should any questions arise concerning the above, please feel free to contact the undersigned at this office.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

JUN 1 1990

May 31, 1990

Serial Letter No.: 315/03360/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Roller Compacted Concrete Foundation Preparation

Gentlemen:

Reference is made to the Government's serial letter no. 133/03360/10.1, dated May 25, 1990, which is the latest piece of correspondence concerning the aforesaid subject matter.

In response to the Government's letter, PCL Civil Constructors offers the following:

1. Truck Mounted Vacuum Pick-Up System:

   In order to facilitate our clean-up operations, PCL Civil Constructors will utilize a truck mounted vacuum pick-up system. However, due to the steep grades at the left and right abutments of the RCC Dam, PCL Civil Constructors and the vacuum truck's manufacturer feel that employing this type of equipment in these areas would be impractical. Hence, PCL Civil Constructors proposes to use high volume, low pressure washing and high pressure water jetting at the abutments. The loose material will be washed to the bottom of the foundation where it would be collected by the specified vacuum truck.

2. Plan for Waste Disposal:

   PCL Civil Constructors plan for waste disposal was originally submitted under serial letter no. 089/03360/10.1 on December 22, 1989. The plan is as follows:

   > All of the rock fragments and loose rock pieces will be loaded, hauled and disposed of in the waste area as depicted in the contract documents. Wash water and small granular particles will be directed into sumps and pumped through a header system as shown on our Dewatering Plan.

Mr. Wiley S. Isom
RE: RCC Foundation Preparation
May 30, 1990

3. Equipment List:

The following equipment will be utilized on the RCC foundation preparation:

1. International 4000 gallon Water Truck
2. John Deere 310 Backhoe
3. Cat 235 Backhoe
4. Vactor 2045 Vacuum Truck or equivalent
5. Lanada PG4 2500 High Pressure Water Jet
6. 190 CFM Air Compressor

I hope the above information addresses all of the Contracting Officer's concerns as related to foundation preparation. Should any questions arise, please contact the undersigned at this office.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

Read 8 Jan 90

PCL

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

December 22, 1989

Serial Letter No.: 089/03360/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Roller Compacted Concrete Foundation Preparation
Joint Treatment Plan

Gentlemen:

Reference is made to Technical Provision 03360, Paragraph 10.1, titled "Preparations for RCC placement", and your Serial Letter No. 28/3360/10.1 and 11.3. Transmitted herewith are four (4) copies of PCL Civil Constructor's Roller Compacted Concrete Foundation Preparation and Joint Treatment Plan for the Contracting Officer's Review.

Our plan for conveying RCC, which was requested by your letter, is still under design. Presently, we have two (2) conveyor companies, Rotec Industries and Morgan Manufacturing, designing custom systems for this project. Once their designs are finalized, our plan will be forwarded to the Contracting Officer for approval. This submittal will be made no later than February 1, 1990.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

PCL

PCL CIVIL CONSTRUCTORS, INC

RIO GRANDE FLOODWAY, T OR C UNIT
CUCHILLO DAM
CONTRACT NO.: DACW47-89-C-0056

ROLLER COMPACTED CONCRETE FOUNDATION PREPARATION AND JOINT TREATMENT PLAN

The information contained herein will serve as PCL Civil Constructors plan for foundation preparation and joint treatment for roller compacted concrete.

I Foundation Preparation:

Prior to placing any concrete, PCL Civil Constructors will clean the rock foundation surface of loose, unkeyed, and deteriorated rock, all accumulations of soil, vegetation, grease, spilled oils, all frozen materials, loose fragmented rock pieces, puddles or ponds of free surface water, and other detrimental materials. The removal of the above materials will consist of the following methods:

A. Shaping and Filling:

Shaping by minor rock excavation (trimming) of obtrusive high points, vertical faces, and overhangs will be performed prior to the placement of any concrete. Depending on the location, size, shape and the quality of the rock, trimming and shaping will be accomplished by one or a combination of the following methods:

1. Mechanical Ripping and Excavation:

Mechanical ripping and excavation will be performed by either a Cat D-9 Ripper, Cat D-8 Ripper or a Cat 245 Backhoe.

2. Hand Pry Bar and Jackhammer:

There may be some instances where mechanical ripping is not feasible or practical. In these instances, PCL Civil Constructors will employ the use of hand pry bars and jack hammers. Presently, there are two (2) jackhammers on the project site.

B. High Volume Low Pressure Washing:

After the area has been shaped and trimmed to grade and all of the large materials have been removed, then PCL Civil Constructors will perform high volume low pressure water washing. High volume low pressure water washing will be accomplished by an International 4,500 gallon water truck equipped with exterior hoses for on-the-ground use. The truck has the capacity of more than 200 gallons per minute.

PCL

C. Truck Mounted Vacuum Pick-up System:

At the present time, PCL Civil Constructors does not see the need for a truck mounted vacuum pick-up system for use in our foundation clean-up. Conventional washing, power sweeping, and other general techniques commonly used in foundation preparation will be employed in lieu of the vacuum truck. If a situation arises that necessitates the use of a vacuum truck, then PCL Civil Constructors will employ the model 2045 Vactor or equal as specified in Technical Provision 02219, Paragraph 6.3.3.

D. Waste Disposal:

All of the rock fragments and loose rock pieces will be loaded, hauled and disposed of in the waste area as depicted in the contract documents. Wash water and small granular particles will be directed into sumps and pumped through a header system as shown on our Dewatering Plan.

II <u>Joint Treatment:</u>

As specified in Technical Provision 03360, Paragraph 14.5, titled, "Horizontal RCC Cold Joints", there are two (2) Types of cold joints. A Type I cold joint occurs when more than 2,000 degree hours have passed before placement of a successive layer of RCC. Preparation of a Type I cold joint will include cleaning the joint at the time when a subsequent lift of RCC is about to be placed. A nominal 1 inch thickness of RCC bedding mortar will be spread over the lift joint before placement of the next RCC layer.

A Type II cold joint is defined as a joint were more than 120 hours (5 days) have passed before placement a successive layer of RCC. Treatment of a Type II joint will consist of removing all laitance, loose debris, and contaminants by high-pressure water jetting (water blasting). After this initial treatment of waterblasting, a Type II cold joint will be prepared in the same fashion as a Type I cold joint. PCL Civil Constructors does not anticipate Type II cold joint being formed on this project. However, a water blaster, Hydro Broom Double Nozzle, capable of 1,500 psi, will be available on the project site if the need for such equipment arises.

Contractor's Dewatering Plan

Rcvd 28 Nov 89

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

November 27, 1989

Serial Letter No.: 044/01565/2.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C Unit, NM

Subject: Dewatering Plan

Gentlemen:

Pursuant to Section 01565 of the Technical Provisions, four (4) copies of PCL Constructors Dewatering Plan are herewith transmitted for the contracting officers approval.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

PCL CIVIL CONSTRUCTORS, INC.

DEWATERING PLAN
FOR
CUCHILLO DAM PROJECT
CONTRACT NO.: DACW47-89-C-0056

This proposed plan for dewatering is to show locations and capacity of dewatering pumps, sumps, collection, and discharge lines to control ground water and surface water.

The temporary dam shown on the plan is designed to divert up to 250 cubic feet per second (CFS.) of ground water and surface water through the lower level outlet works. This will keep the construction area at the dam structure free from water. The lower level outlet works consists of a 60" pipe which is capable of 250 CFS.

As per Section 01565 Dewatering and Care of Water, Paragraph 3, flow in excess of 250 CFS will be considered cause for equitable adjustment. The 250 CFS would be measured at the U.S.B.R. gaging station shown on the plans and as indicated in the specifications.

Excess water shall flow through the existing channel during construction of the lower level outlet works, then, upon completion, the temporary diversion dam shall divert water through the low level outlet works. The dewatering operations shall pump ground water encountered during the foundation excavation.

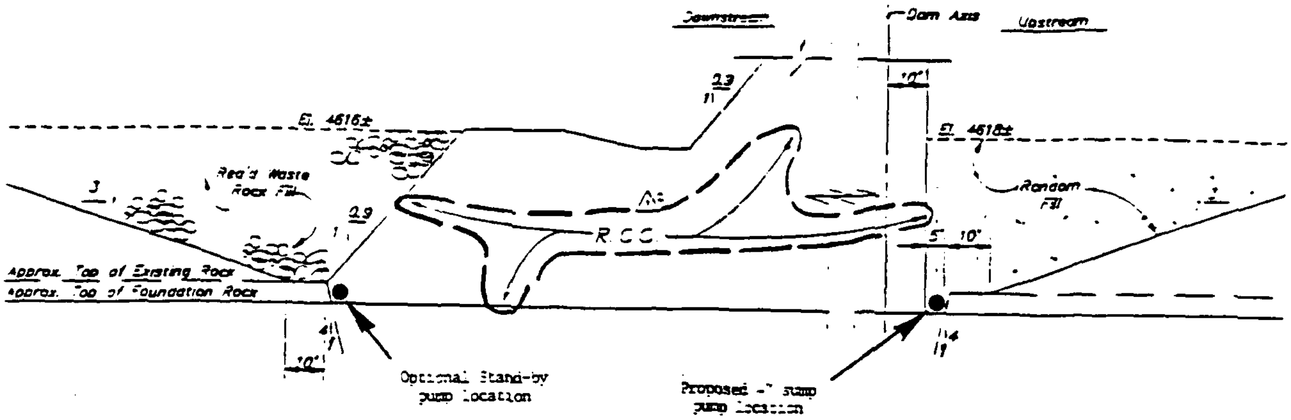
The three dewatering pumps shown on the standard work drawings submitted herewith are used for dewatering at the dam structure during construction.

Collection and discharge lines are shown on standard work drawing SW-9 and are as follows:

1. Discharge lines #1, #2, and #3 are approximately 200 feet long and discharges excess water which may pass through the temporary diversion dam to keep the construction area free from water. Discharge pump #1 is a 4 inch sump pump which will be used as the main dewatering pump. Pump #2 is a 6 inch trash pump and pump #3 is a 3 inch trash pump which will be used on a stand-by basis.

2. Discharge line #4 transports water from the storage pond approximately 25 feet to the crusher and batch plant site.

3. Collection line #2 pumps water from the existing well, which will be used as the primary water source, to the storage pond and to the batch plant site. The line is approximately 600 feet and the well is approximately 100 feet deep.



DAM STRUCTURE SECTION

Notes:

Notes:

1. The temporary di- -sion dam will be approximately 75 feet long. Ac ual length shall be determined in field at time c construction.

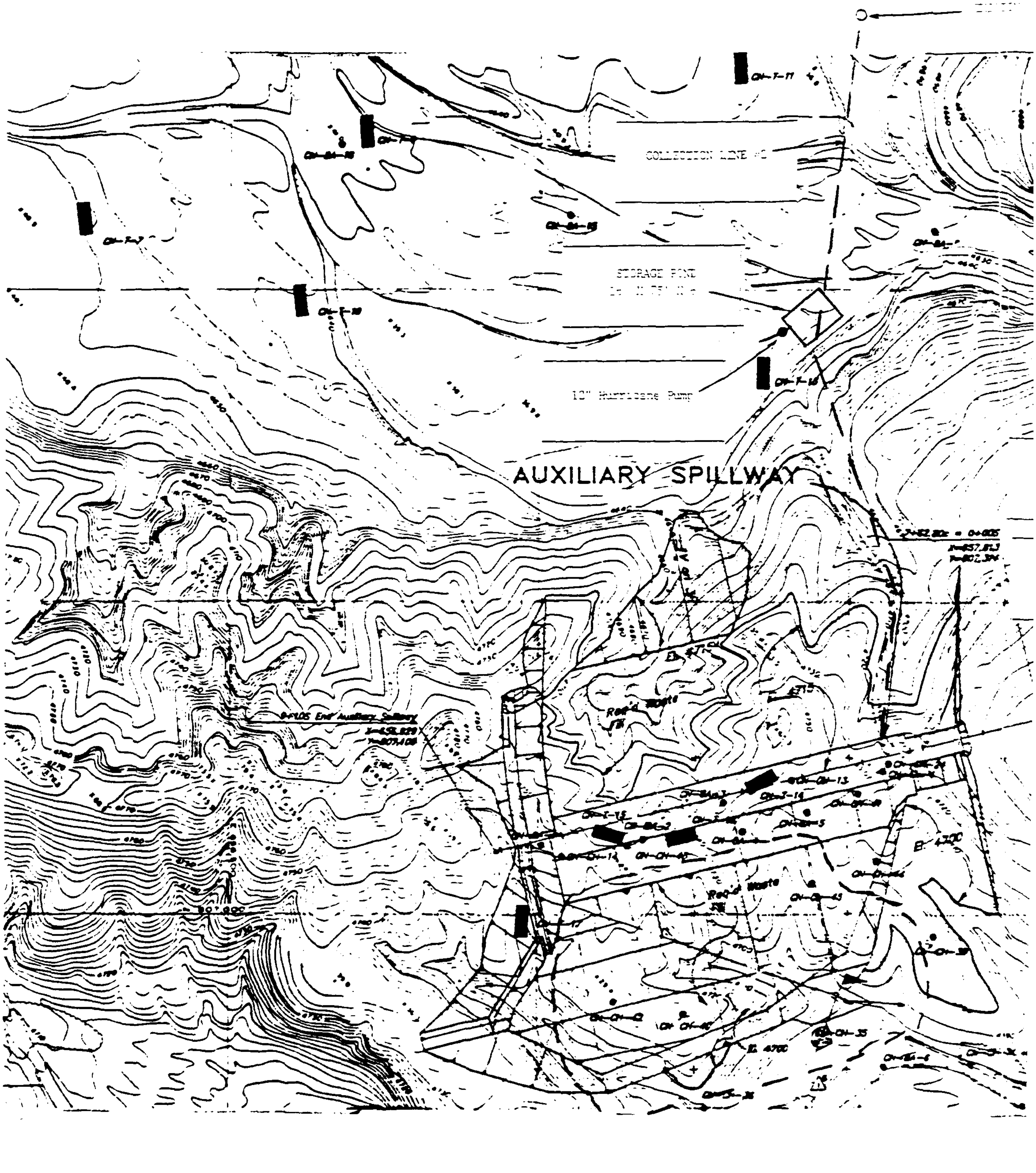
2. Locations are tentative and are subject to changes.

3. The temporary diversion dam shall be constructed using acceptable semi-impervious fill material.

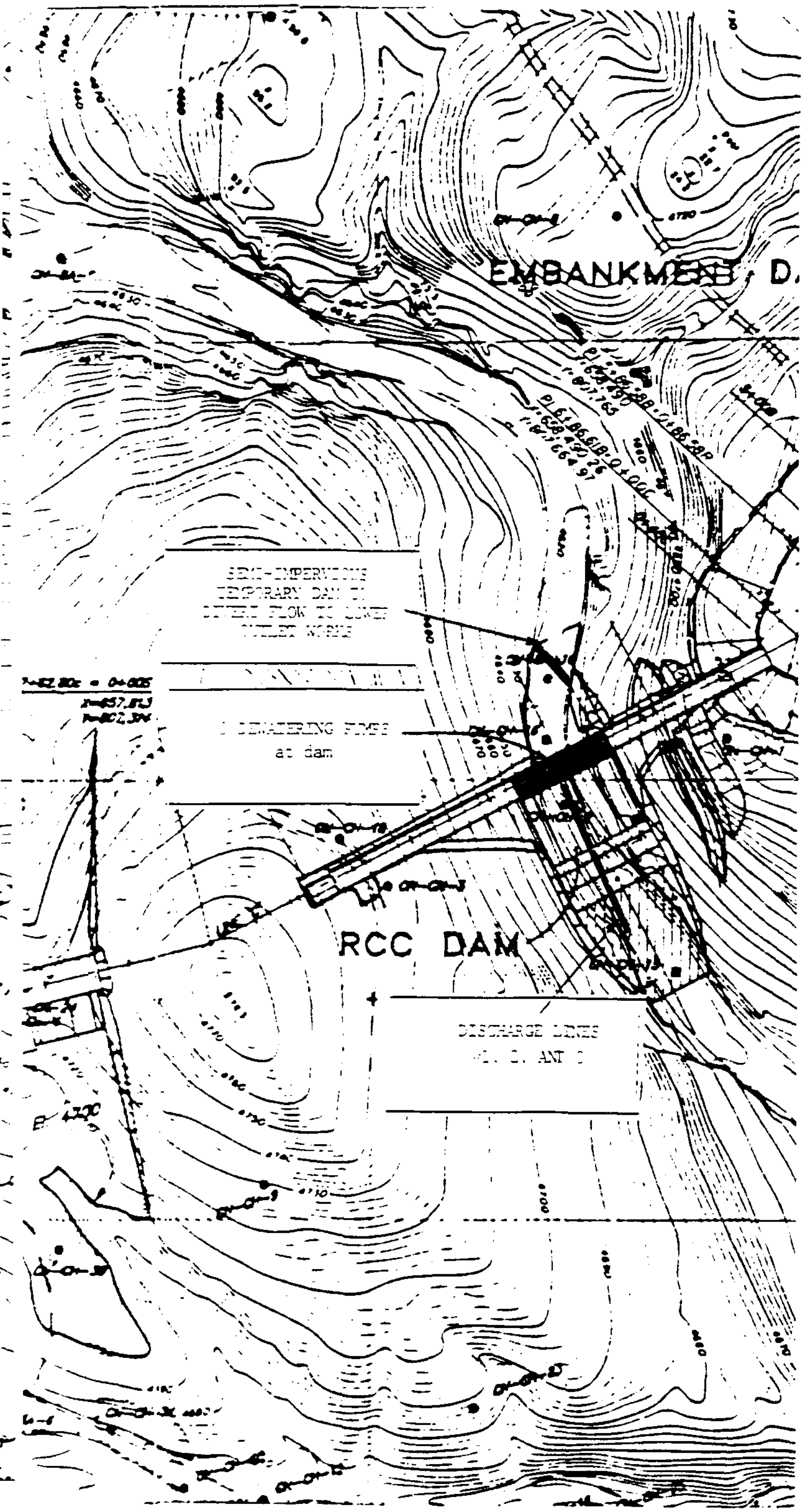
4. Stand-by pump locations will be dictated by actual field locations.

5. Rock rip rap shall be placed at outlet of dewatering pumps for erosion control.

P C L CIVIL CONSTRUCTORS
RIO GRANDE FLOODWAY (CUCHILLO DAM)
Dewatering Pump Locations at Dam Structure
Jm 11-27-89



AUXILIARY SPILLWAY
12" Hurricane Pump



NOTES:

1. Locations are tenative and are subject to change.

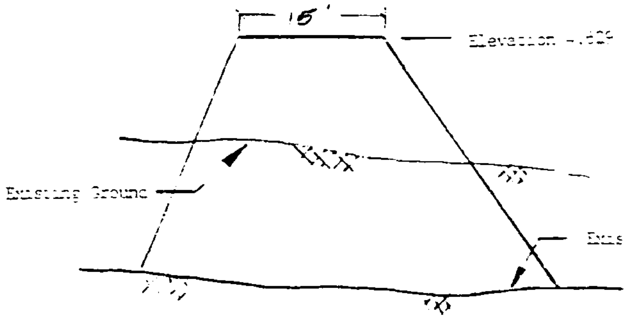
2. Nuisance water from dewatering may be pumped to storage pond if needed.

3. Temporary dam shown will divert river to lower outlet works. The lower outl works will handle 250 cubic feet per s

4. Three dewatering pumps will remove exc water during construction of dam struc as secondary dewatering.

5. Prior to the installation of pumps, manufacturer's literature will be forwarded to the contracting officer for approval.

6. An additional well may be drilled if quantity of water from existing well is insufficient to supply construction needs.



TEMPORARY DIVERSION DAM

Not to Scale

P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCHILLO DA

DACW47-89-C-0056

Dewatering and care of water operations

DWN.	DATE	CKD.
Jm	11-22-89	TAo

DWG NO. SW-6

PCL

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

December 22, 1989

Serial Letter No.: 057/01565/2.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Dewatering Plan

Gentlemen:

As per your Serial Letter Number 14/01565/2.1, the enclosed is additional information to be incorporated into the Dewatering Plan

Discharge pump #1 is a 4 inch sump pump designed to pump 400 gallons per minute which will be the main dewatering pump. Pump #2 is a 6 inch trash pump with capacity of 1,500 gallons per minute and pump #3 is a 3 inch trash pump with capacity of 600 gallons per minute. Both pumps #2 and #3 will be used as optional stand-by pumps. All discharge lines shall be aluminum quick coupling irrigation type or standard flexiable hose.

The existing well is to house a 7-1/2 hp. pump capable of 300 gallons per minute.

The plan for diverting water to the small arroyos to the south of the dam is to set rip rap or various size rock into a pit to control erosion. The discharge into the rip rap is to slow the outlet rush of water to the south of the dam, and to allow seepage into the existing gravel as ground water. This shall create close to an existing condition downstream.

P.O. Box 2270, Truth or Consequences, N.M. Telephone 505-743-7834 Rapidfax 505-743-7836

As per Section 01565 Dewatering and Care of Water, Paragraph 3, flow in excess of 250 cfs that damage permanent work or previously prepared foundations will be considered cause for equitable adjustment. The 250 cfs would be measured at the U.S.B.R. gaging station shown on the plans and as indicated in the specification.

The temporary diversion dam shall be used to divert water from the Cuchillo Negro creek channel through the lower level outlet works during construction of the dam structure. The diversion dam will be constructed as follows:

1. The required random fill will be backfilled on the upstream face of the dam to the invert elevation of the lower outlet works pipe. (elev. 4618).

2. The diversion dam will be constructed of semi-impervious materials in the following dimensions:

   Length = 110 ft.
   Height = 10 ft.
   Top Width = 10 ft
   Side Slopes = 1V or 1H

Please note all locations, materials and sizes of pumps and lines are subject to change depending on availability, source and final conditions.

Sincerely,

Thomas R. O'Donnell
Project Engineer

JM:deo

PCL

PCL CIVIL CONSTRUCTORS, INC.

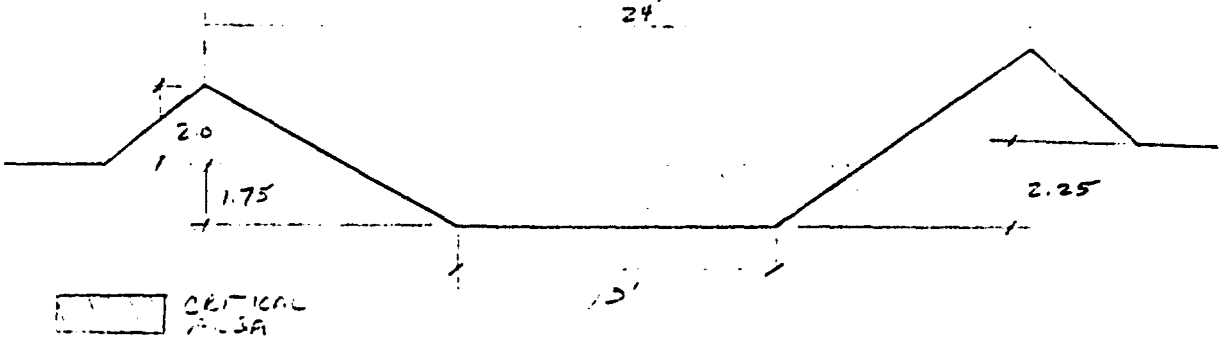
Construction Since 1906

MAY 21 1990

P.O. Box 2270, Truth or Consequences, N. F-20 Telephone 505-743-7834 Rapidfax 505-743-7836

OPEN CHANNEL FLOW MEASUREMENTS

Measurements ... at ... as follows:



$A = \text{Area} = (10 \cdot 1.75') + (1.75' \cdot 3.2') = 23.3\,ft^2$

$S = \text{Slope} = \frac{.3'}{5400} = 0.005$

$r = \text{hydraulic radius}$
$= 10' + (\sqrt{1.75^2 + 3.2^2})(2) = 17.5\,ft$

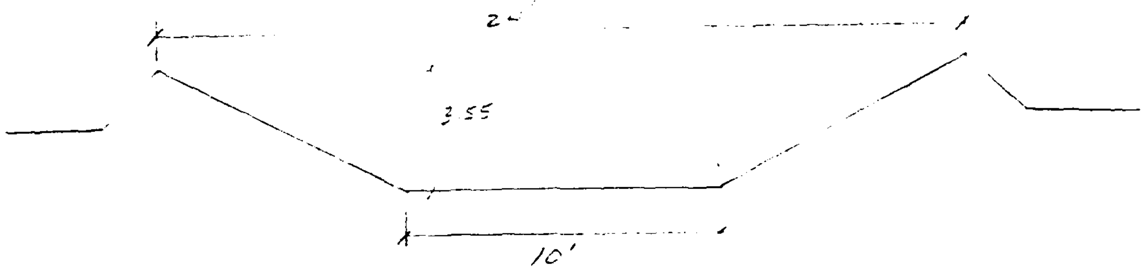
$Q = AV = \text{Manning eq} = \frac{1.49}{n} (r)^{2/3} \sqrt{S}$ ...

$n = 0.06$ for ...

$\therefore Q = 23.3\,ft^2 \cdot \frac{1.49}{0.06} \cdot (17.5\,ft)^{2/3} \cdot \sqrt{0.005}$

$= 23.3\,ft^2 \cdot 24.8 \cdot 6.75 \cdot 0.07 = 277\,cfs$

∴ ... 1.75' ... bottom ... 10



CONSIDER AREA TO TOP OF BERM:

$$A = (10' \times 3.55) + (7' \times 3.55) = 60.4\ ft^2$$

$$S = 0.005$$

$$r_h = 10' + (\sqrt{3.55^2 + 7^2})(2) = 25.7\ ft$$

$$Q = Av = 60.4\ ft^2 \cdot \frac{1.49}{0.06} \cdot (25.7\ ft)^{2/3} \cdot \sqrt{0.005}$$

$$Q = 60.4 \cdot 24.8 \cdot 8.7 \cdot 0.071 = 925\ CFS.$$

Contractor's Plan to Remove Differing Site Condition Material

PCL CIVIL CONSTRUCTORS, INC.
RIO GRANDE FLOODWAY, T OR C UNIT
CONTRACT NO.: DACW47-89-C-0056 (CUCHILLO DAM)
CHANGE ITEM 24, CORPS FILE C-37
REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF OPERATION

PCL CIVIL CONSTRUCTORS, INC.
CONTRACT NO.: DACW47-89-C-0056
CHANGE ITEM NO. 24: REMOVAL OF DIFFERING SITE CONDITION MATERIAL
PLAN OF OPERATION

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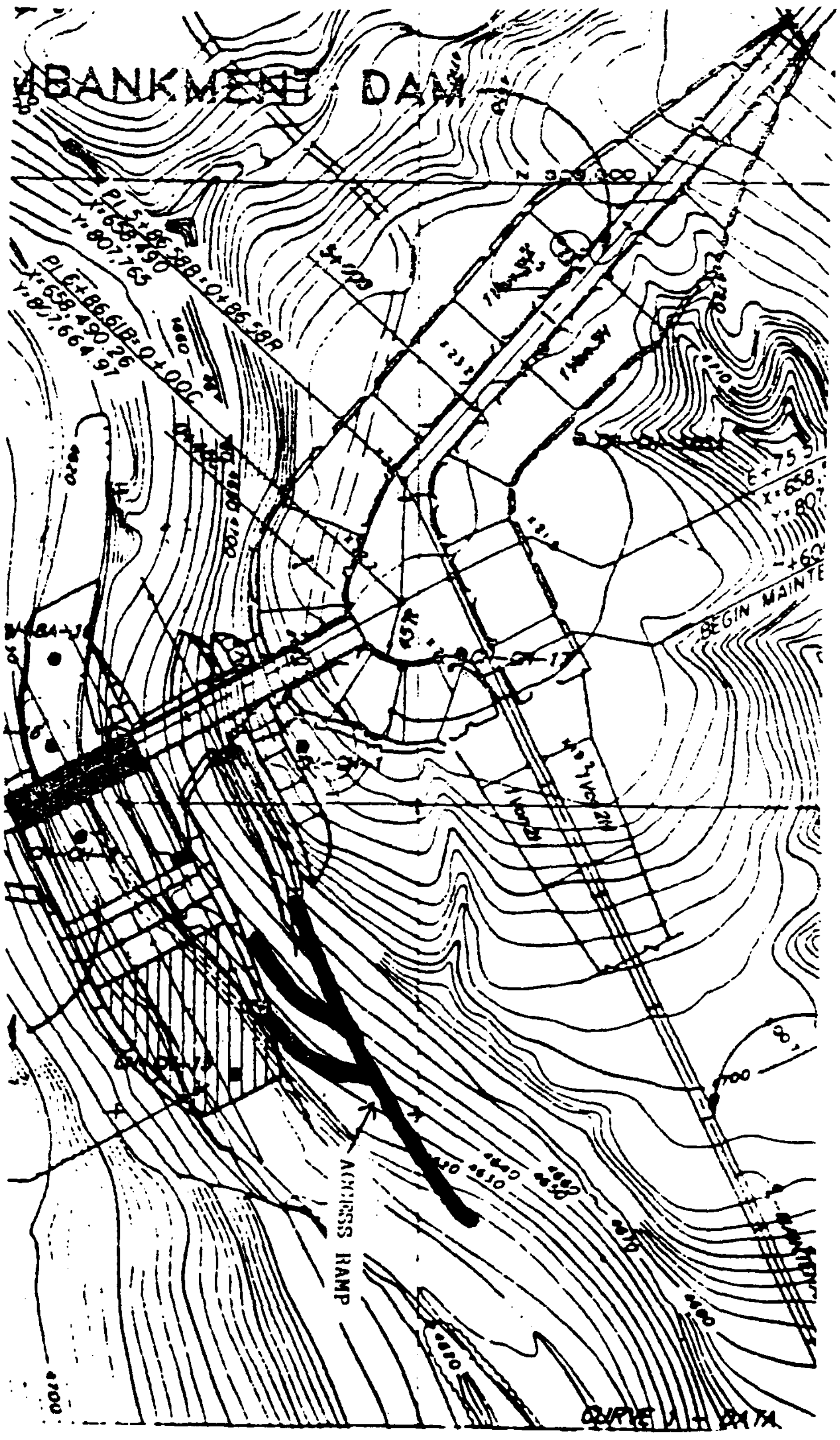
CHANGE ITEM NO: 24

REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF OPERATION

PART I

PLAN OF EXCAVATION



P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (CUCHILLO DAM)

RFP "C-37"

Excavation Plan

Access Ramp

PCL CIVIL CONSTRUCTORS, INC
RIO GRANDE FLOODWAY, T OR C UNIT
CHANGE ITEM NO. 24: REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF EXCAVATION

==

The first step in the removal of the differing site condition material is to remove certain safety features at the High Level Outlet Works which will hinder the drilling operations. These safety features include the wire mesh at the left abutment of the RCC Dam, the safety handrail, the stairway to the High Level Outlet Works and other miscellaneous equipment and supplies. The removal of these items will be performed while the drilling and blasting equipment is being mobilized to the project site.

In order to gain access to the left abutment of the RCC Dam, an access ramp will be constructed downstream of the excavation as shown on the Corps of Engineers sketches. This ramp will allow the drilling equipment and excavation equipment to access each stage of the excavation. The ramp will be constructed as shown on the enclosed drawing "C37-1" with an approximate width of 10 feet and a grade of approximately 17 percent.

The removal of the differing site condition material at the left abutment of the Roller Compacted Concrete Dam will be accomplished in two benches. The first bench will start at the top of slope at the High Level Outlet Works, which will be marked by the C.O.E. Geologist, and proceed to a total depth of excavation of approximately 15 feet. The drilling, shooting and excavation will commence at the downstream limits (Sta. 3-50D ±) and progress upstream. The second bench will continue to the bottom limits of the excavation which is the well defined limestone band at the approximate elevation of 4640. Drilling and blasting will be performed by McCaw's Drilling (USA), Inc., which is PCL Civil Constructors subcontractor for this specialized work. Techniques of controlled blasting which will be employed in the prosection of this change is presented in Part II of this plan.

Mucking of the shot rock at each bench level will follow the drilling and shooting in as much as possible. The shot material at the first bench will be "backcasted" to the second bench using a Cat EL 300 Backhoe. The shot material at the second bench will then be "backcasted" to the Low Level Outlet Works bench using the same hydraulic excavator. All the shot material at the Low Level Outlet Works bench will then be rehandled again to the dam foundation floor. Once the material is deposited on the dam foundation floor, it will be loaded and hauled to the waste area, as shown on the original contract documents, using Caterpiller 769 Off Highway Trucks.

CHANGE ITEM NO: 24

REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN OF OPERATION

PART II

BLASTING PROPOSAL (McCAW'S DRILLING)

Table of Contents

Description	Section
General Procedures -------------------------------	1
Initiation System --------------------------------	2
Blast Design -------------------------------------	3
Product --	4
MSDS Data Sheets ---------------------------------	5
Magazine Location & Specifics --------------------	6
Safety ---	7

GENERAL PROCEDURES

1) All blasting will be done by experienced and competent personnel employed by McCaw's Drilling (USA) Inc. Technical assistance will be supplied by:

   a) Woodard Explosives
      P.O. Box 12356, Station F
      Albuquerque, NM 07195
      Phone: (505)877-2400

   b) Atlas Powder Company
      6851 South Holly Circle
      Suite 100
      Englewood, CO 80112
      Phone: (303)779-1200

2) Resumes of the on-site personnel for McCaw's Drilling (USA) Inc. (Mr. Kevin Joe and Mr. Kevin Stevenson) were submitted earlier in the project and subsequently approved by the contracting officer.

3) Explosives products will be stored at a location within the project boundaries as approved by the contracting officer. The location will be selected to comply with all local, state and federal laws, as well as, the United States Army Corps of Engineers Manual - EM385.1-1, section 25.A-19. Magazines have been federally inspected and meet the requirements of the Bureau of Alcohol, Tobacco & Firearms, as outlined in 27 CFR55, subpart K.

4) Explosives products and accessories will be supplied by Woodard Explosives of Albuquerque, NM - (505)827-2400. The explosives products that we anticipate using on this project are as follows.

   a) <u>Atlas High Explosives</u>

      i) Gelmax (1", 1 1/2" & 2" diameter)

   b) <u>Ensign Bickford Products</u>

      i) Short period electric caps (period 1 to 20)
      ii) E-Cord (35 grains per foot)
      iii) Primacord (200 grains per foot)

5) Our firm will be submitting detailed blasting reports for each blast per section 7-21-5 and section 7-6 of the contract documents. In addition to this, we will have three VMS 500 seismographs which will be used to measure and record peak particle velocity, amplitude, frequency and overpressure (air blast) in the vicinity of the blast and the structures at risk per section 25-C of Corps manual - EM 385-1-1.

INITIATION SYSTEM

1) For this portion of the work, we will be using an electric system of initiation, in-hole detonators and tie-in. For precise blasting operations where delayment is critical, it has been our experience that electric systems tend to give the more precise control required for this type of work.

BLAST DESIGN

1) Our general approach to this portion of the work will be as follows:

The left abutment will be blasted in two benches. The first bench will be at a height of 15'.

The second bench will be to the bottom of the well defined limestone band or the top of the clay infill material (approximate elevation - 4644.0).

Blasting will begin at the downstream limit of the excavation and progress upstream. The delayment, patterns and tie-in sequences will be determined in the field by trial blasts and the results of the seismograph monitoring. Generally, our patterns for production blasting will be 4' X 4' and 5' X 5' and hole diameters shall not exceed 3".

The spacing for wall control holes will be 24" c/c or as approved by the Contracting Officer.

The column loads will be determined by the results of our trial blasts and will be detailed on our preliminary blast proposal forms as required per section 7.2-1.5 and section 7-6 of the contract documents.

MAGAZINE LOCATION & SPECIFICATIONS

1) Specifications

a) High Explosives Magazine

Type:	Type 2 with skids
Dimensions:	8 X 8 X 10
Capacity:	12,500 lbs
Construction:	1/4" steel with interior lining of 2" of hardwood, and 1/2 " plywood or particle board.
Ventilation:	Adequate
Locks:	Two American locks with 7/16" shackles. The locks have hooded covers.

b) Detonator Magazine

Type:	Type 2 portable with skids
Dimensions:	3' X 3' X 5'
Capacity:	2000 caps (approximately 5 lbs explosives)
Construction:	1/4" steel with interior lining of 2" of hardwood, and 1/2" plywood or particle board.
Ventilation:	Adequate
Locks:	Two American locks with 7/16" shacks. The locks have hooded covers.

2) Security of Magazines

The magazines will have locks in accordance with ATF Publication - Page 5400.7 (11/82). The magazines will be kept locked at all times while unattended. "No Trespassing" signs will be posted at appropriate locations around the magazine site.

SAFETY

1) On this project, we will be following the safety program established by the general contractor, including testing for substance abuse.

In addition, to this we will have an orientation with each new employee specifically tailored to working with explosives.

The receiving, transporting, handling and use of explosives will be in accordance with all applicable local, state and federal laws and the United States Army Corps of Engineers Manual EM 385-1-1, Section 25.A-19.

Prior to commencement of blasting, a survey will be made at the blast site to check for extraneous electricity.
During loading operations, we will have a model 350 lightning detector set up to monitor atmospheric static electricity. The detector is equipped with two warning systems - "Light and Sound", each blast will be covered with 10' X 15' rubber blasting mats to prevent fly rock. During loading operations, persons not directly involved in the blasting operations will not be allowed in the blast area. All blasting operations will be conducted with maximum emphasis on safety and in accordance with the Corps of Engineers publication EM285-1-1.

PCL CIVIL CONSTRUCTORS, INC.
RIO GRANDE FLOODWAY, T OR C UNIT
CHANGE ITEM NO. 24 - REMOVAL OF DIFFERING SITE CONDITION MATERIAL

PLAN TO PROTECT OUTLET STRUCTURES

I Low Level Outlet Work:

The first step in the protection of the Low Level Outlet Works is to salvage all of the removable components of the structure without subjecting PCL Civil Constructors employees to the slope stability hazard of the left abutment of the RCC Dam. Concrete formwork and reinforcing steel will be removed and salvaged at the intake structure, 60" pipe encasement and the stilling basin. In addition, all safety handrail, lumber walkways and miscellaneous supplies will be removed from the Low Level Outlet Works area. Some components of this structure are either impossible to remove or are hindered due to safety considerations. These components will remain and be replaced after the changed work is completed.

The next step in the protection of the Low Level Outlet Works is to cover the structure with a protective layer of sand. PCL Civil Constructors will use a screened 3/8-inch minus sand, meeting the gradation requirements of the Roller Compacted Concrete fine aggregate. This material will be loaded and hauled from our present stockpile area to the top of the left abutment of the RCC Dam using Caterpillar 769 Off Highway Trucks. Placement of the protective sand will be accomplished using a Manitowoc 4100 Series 2 Crane and two yard concrete buckets. The concrete buckets will be filled using a Michigan L70 Front End Loader and lowered to the Low Level Outlet Works using the Manitowoc Crane.

After the differing condition material is excavated and removed from the left abutment of the RCC Dam. Bulk clean-up of the protective sand will commence. Bulk clean-up will consist of machine and hand removal. Approximately two thirds of the material will be removed using a John Deere 310 C Backhoe which will leave approximately one third to be removed by hand. Final clean-up of the protective sand will consist of vacuuming, air/water jetting and high pressure washing of the Low Level Area floor, walls, 60" pipe and pipe pedestals.

II High Level Outlet Works:

Protection of the High Level Outlet from the affects of blasting will be accomplished using blasting mats and seismographs which will be used to measure peak particle velocity, amplitude, frequency and air blast at this structure. All blasting will be controlled to keep the maximum peak particle velocity at this structure to 2 inches/second. The technique which will be employed to minimize the effects of blasting on the structures is explained in detail in The Blasting Proposal Section of this plan (Part II).

Government's Directive to Remove Differing
Site Condition Material

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
SOUTHERN AREA OFFICE
P.O. BOX 6096, FORT BLISS, TEXAS 79906
FAX (915)568-1348

REPLY TO ATTENTION OF:

November 26, 1990

Construction-Operations Division

Serial Letter No. 239/P00024

SUBJECT: Contract No. DACW47-89-C-0056, Cuchillo Dam, Rio Grande Floodway, T or C Unit, Sierra County, NM; Modification P00024 and Direct of Work

PCL Civil Constructors, Inc.
P.O. Box 2270
Truth or Consequences, NM 87901

Gentlemen:

As a result of a meeting at the job site on November 21, 1990 to discuss the scope of work necessary to remove material on the left dam abutment, I have determined it to be in the best interest of the Government to direct some aspects of your work. You are directed to proceed with removing the material on the left abutment as previously directed in Modifications P00022 and P00024, however your performance shall conform to the following:

A. Do not construct a temporary road from the HLOW bench, downstream to the canyon floor. Drilling equipment can be placed by crane. It is anticipated that this is the only equipment necessary at the HLOW bench.

B. Drill and blast pre-split holes at 2 foot centers along the HLOW bench to a depth of approximately 30 - 35 feet. It is the intent to construct an intermediate bench at approximate elevation 4655, just above the lower-most ledge of limestone. Due to the type of material in this area, production drilling and blasting is not believed necessary. All drilling and mucking shall progress from downstream to the dam axis.

C. A temporary haul road should be constructed from the downstream canyon floor up to the intermediate bench. This road should be wide enough (20' +/-) to safely allow for backing of hauling equipment. A low berm constructed on the downslope edge of this road would provide an added measure of safety.

D. Excavation of the material above the intermediate bench shall be accomplished by equipment located on the intermediate bench, placing material from the excavation directly into hauling equipment located on the intermediate haul road/bench. A waste area downstream of the spillway will be located by the Resident Engineer in the field. In the event any oversize material is encountered, it can be pushed over the bench and down into the canyon. In the meeting, Mr. O'Donnell expressed a safety concern with putting equipment on the intermediate bench. It is anticipated that the bench will

have a minimum width of 25 feet. Since the hauling equipment is approximately 14 feet wide, and your excavator requires a minimum of 16.5 feet to swing, I believe the bench will be wide enough. Another concern is with the integrity of the limestone underlying the bench itself. Although this item will be closely watched by all parties while equipment is on the bench, I believe the situation will be safe. It appears from the exposed face of this ledge that the material is competent. Equipment will only be on portions of the bench from which the heavy load of overburden has been removed. The rock units exposed on this face dip inward towards the face of the excavation.

E. After excavating the material above the intermediate bench, drill and blast the remaining limestone ledge from the intermediate bench. It is believed that production holes will be required. Excavation from this area should be removed in a fashion similar to the process used above the intermediate bench.

F. Removal of LLOW protection sand shall be by vacuum truck.

G. Excavation above the intermediate bench should begin as soon as pre-split drilling proceeds a sufficient distance along the bench. This will allow for the minimum of lost time if this method of work does not progress as anticipated.

H. The necessity of having a blasting consultant on site at all times is questionable. The cost of $600/day is also questionable since this service is usually provided by blasting-material manufacturers at no cost. A blasting consultant shall only be used for a maximum of two days, unless otherwise directed by the Resident Engineer.

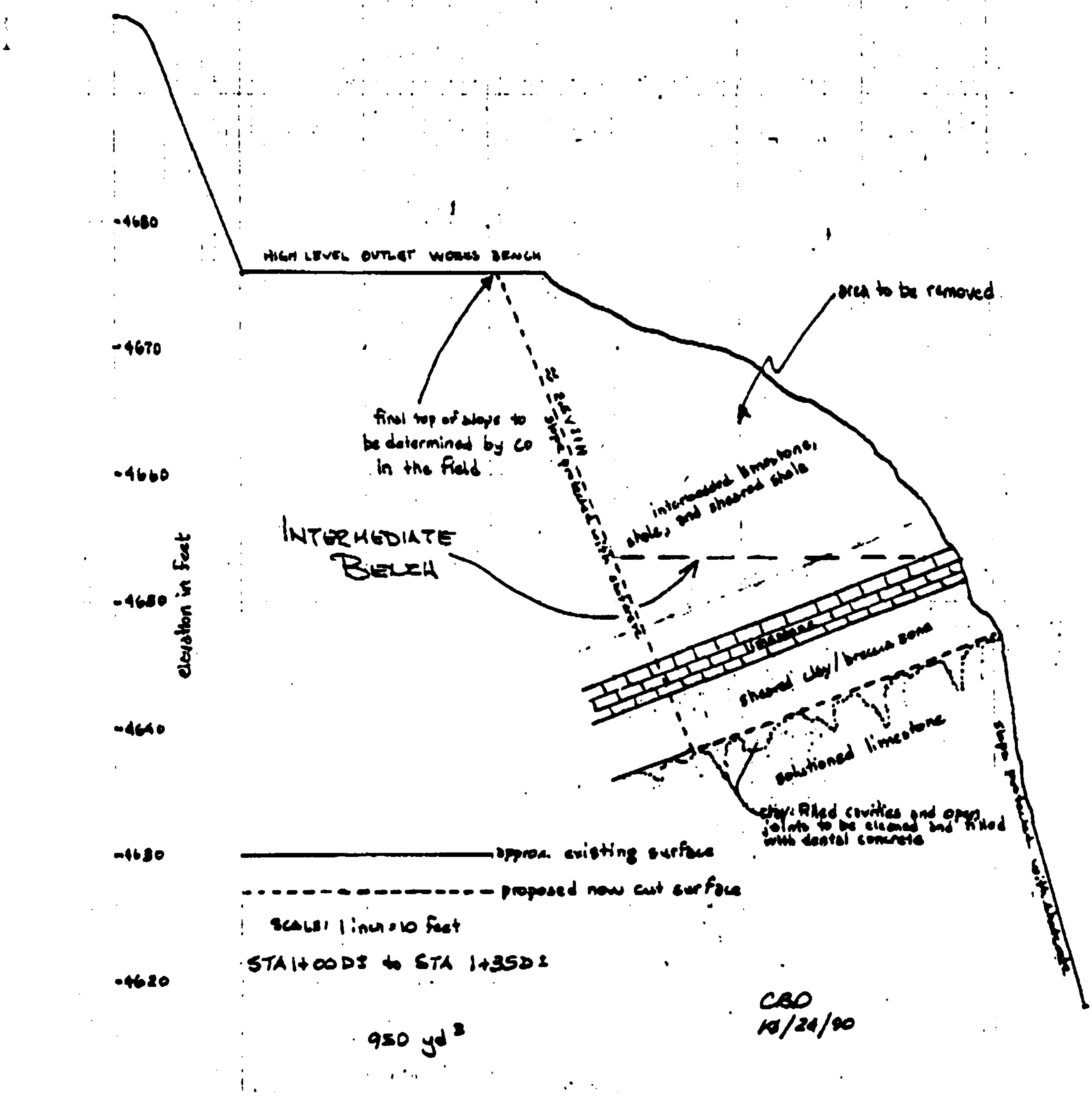
The above direction-of-work may be modified by the Resident Engineer as conditions warrant. This direction has been developed by my staff after discussions with Mr. O'Donnell. Although we are directing some items of work, we still appreciate PCL's input and ideas on this matter. Although I believe the above direction will result in the most efficient method of accomplishing this additional work, I would hope that any ideas which PCL may have to minimize delays as the work progresses will be shared with us. Although you may not agree with the Government's approach as being the best, I am confident that PCL and its staff will cooperate in a professional manner to accomplish this work in the most expedient and efficient manner possible, mitigating any delays to either party.

Sincerely,

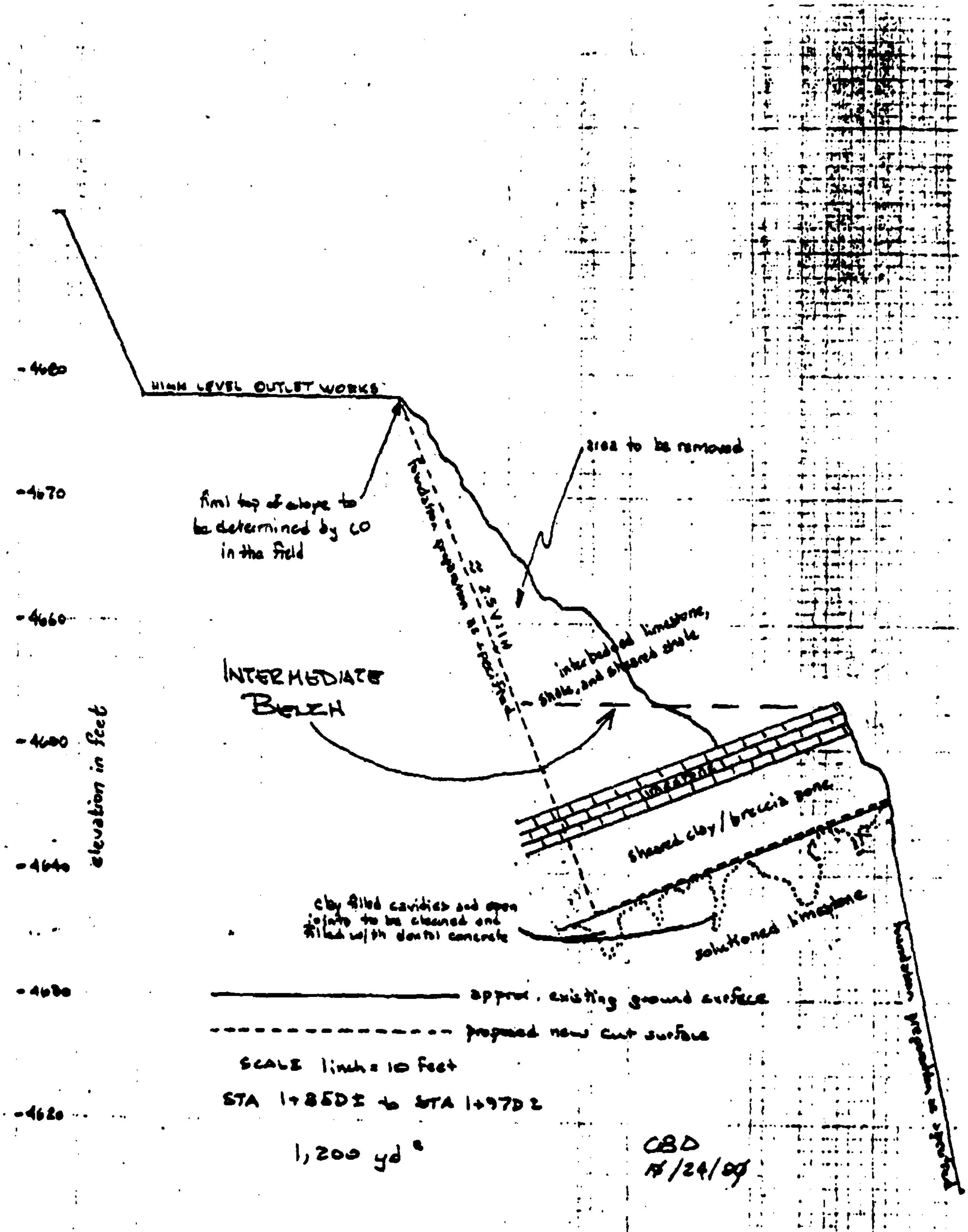
DAP

Donald A. Pfister, PE
Administrative Contracting Officer

Copy Furnished:
N.C. Tennock Dist. Manager
DAP/slr



4680
4670
4660
4650
4640
4630
4620
elevation in feet
HIGH LEVEL OUTLET WORKS BENCH
area to be removed
final top of slope to be determined by CO in the field
interbedded limestone, shale, and sheared shale
INTERMEDIATE BENCH
limestone
sheared clay/breccia zone
solutioned limestone
clay filled cavities and open joints to be cleaned and filled with dental concrete
approx. existing surface
proposed new cut surface
SCALE: 1 inch = 10 feet
STA 1+00 DS to STA 1+35 DS
950 yd³
CBO
10/24/90


4680
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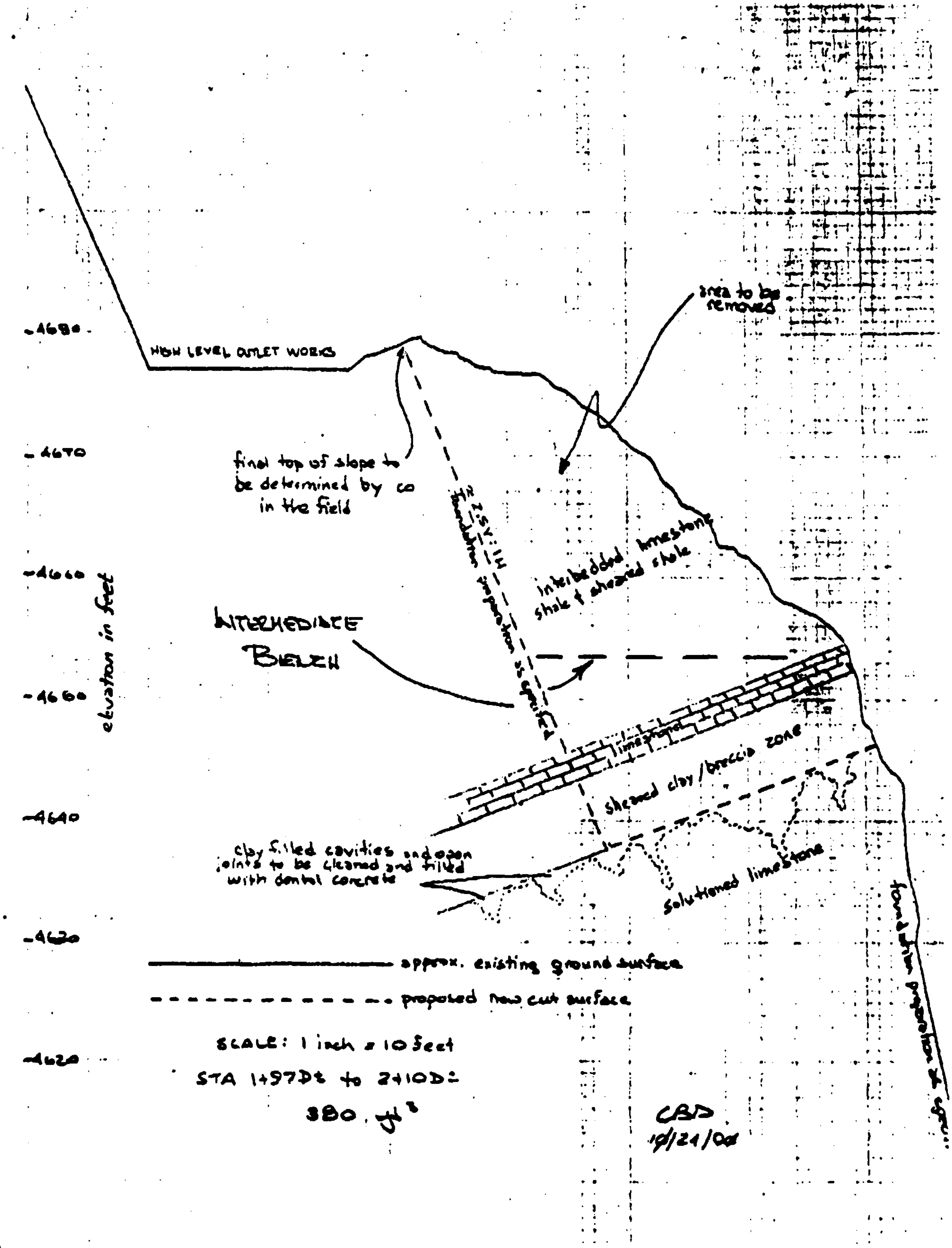
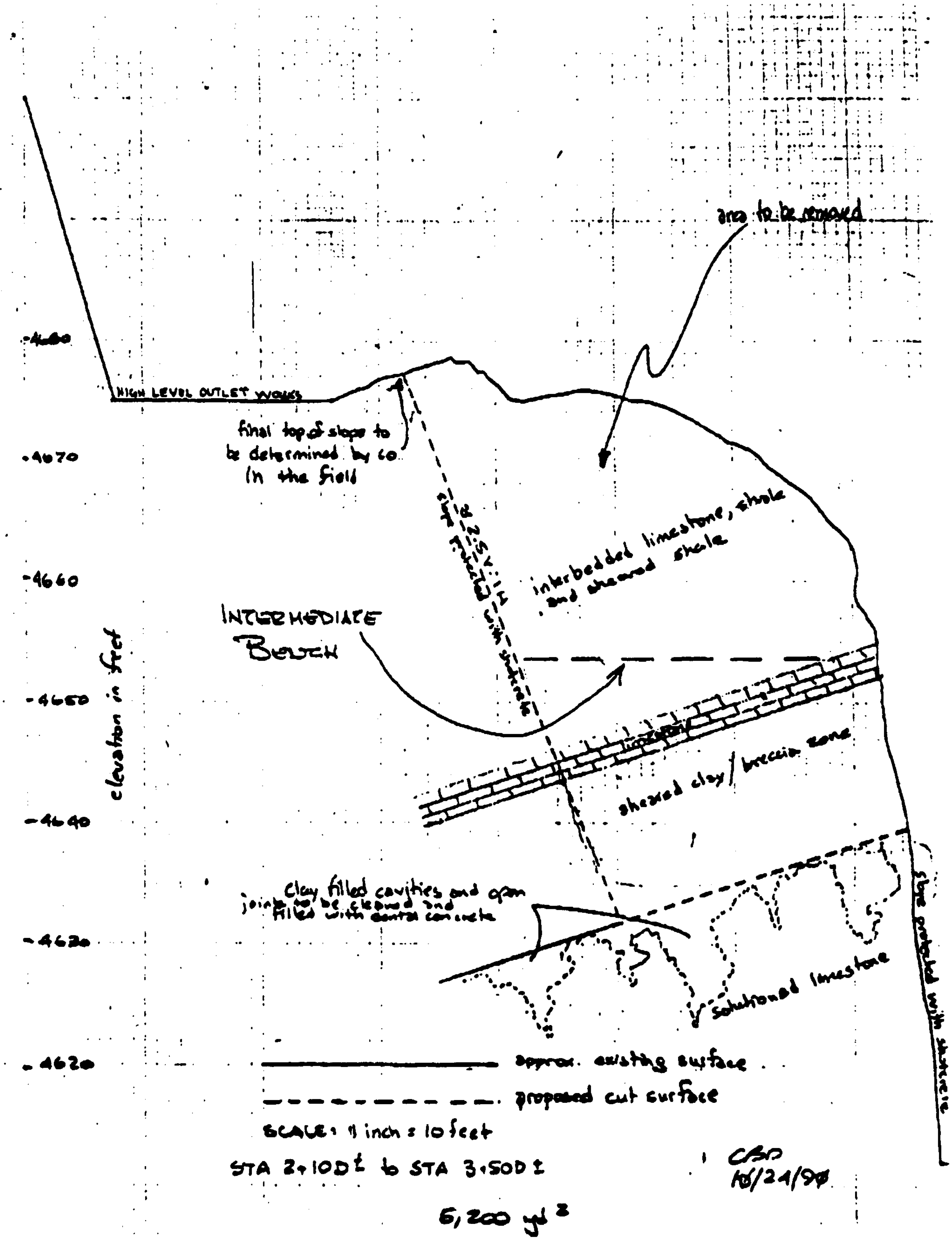
4620
elevation in feet
HIGH LEVEL OUTLET WORKS
final top of slope to be determined by CO in the field
slide to be removed
interbedded limestone, shale, and sheared shale
INTERMEDIATE BENCH
LIMESTONE
sheared clay / breccia zone
clay filled cavities and open joints to be cleaned and filled with dental concrete
solutioned limestone
approx. existing ground surface
proposed new cut surface
SCALE 1inch = 10 feet
STA 1+85D2 to STA 1+97D2
1,200 yd³
CBD



HIGH LEVEL OUTLET WORKS
area to be removed
final top of slope to be determined by co in the field
interbedded limestone shale & sheared shale
INTERMEDIATE BENCH
limestone
sheared clay/breccia zone
clay filled cavities and open joints to be cleaned and filled with dental concrete
solutioned limestone
elevation in feet
approx. existing ground surface
proposed new cut surface
SCALE: 1 inch = 10 feet
CBD


area to be removed
HIGH LEVEL OUTLET WORKS
final top of slope to be determined by CO in the field
interbedded limestone, shale and sheared shale
INTERMEDIATE BENCH
limestone
sheared clay/breccia zone
Clay filled cavities and open joints to be cleaned and filled with dental concrete
solutioned limestone
4670
4660
4650
4640
4630
4620
elevation in feet
approx. existing surface
proposed cut surface
SCALE: 1 inch = 10 feet
STA 2+10D± to STA 3+50D±
CBD 10/24/90
6,200 yd³

Contractor's Wire Mesh Installation Plan

Rcvd 18 Dec 89

PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

December 15, 1989

Serial Letter No.: 080/02219/10.2

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Wire Mesh Installation Plan

Gentlemen:

Pursuant to Section 02219 of the Technical Provisions, four (4) copies of PCL Civil Constructors wire mesh installation plan are herewith transmitted for the Contracting Officers approval.

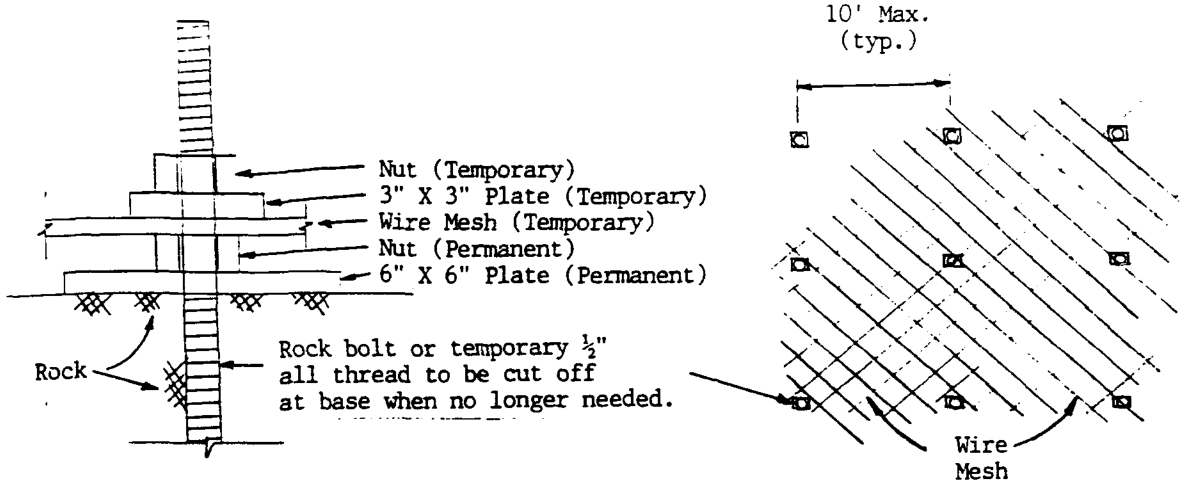
Sincerely,

Thomas R. O'Donnell
Project Engineer

JM:deo

enclosure

P.O. Box 2270, Truth or Consequences, N.M. Telephone 505-743-7834 Rapidfax 505-743-7836
"AN EQUAL OPPORTUNITY EMPLOYER"



WIRE MESH MOUNTING DETAILS

NOT TO SCALE

NOTE:

1. The nut and plate shown to hold wire mesh in place is temporary and shall be attached to a permanent rock bolt or a temporarily installed allthread rod.

2. Allthread installed where rock bolts are not required shall be cut off at ground level when wire mesh is no longer needed.

3. Maximum spacing shall be 10 feet for allthread rod needed. Spacing for rock bolt shall be as directed by the Contracting Officer.

4. The temporary nut and plate used for securing the wire mesh shall not conform to the nut and plate specification for rock plating due to the temporary nature in which they are used.

5. Wire mesh shall conform to specification Section 02219-10.2 of the contract specifications.

6. Allthread used to mount wire mesh temporarily shall be imbedded into the rock 2.5 feet using the same method as rock bolts, with 6 inches protruding to place temporary plate and nut.

P C L CIVIL CONSTRUCTORS

RIO GRANDE FLOODWAY (COCHILLO DAM)

INSTALLATION PLAN
OF WIRE MESH ON
ROCK SLOPES

SW-14

T or C Field Ofc

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE
(Read instructions on the reverse side prior to initiating this form)

02 FEB 1990

DATE: January 29, 1990

XX NEW SUBMITTAL
☐ RESUBMITTAL

Section I — REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the contractor)

TO: Construction Branch
USAED Albuquerque
P.O. Box 1580
Albuquerque, NM 87103-1580

FROM: PCL Civil Constructors
P.O. Box 2270
Truth or Consequences, NM

CONTRACT NO.: DACW47-89-C-0056

TRANSMITTAL NO.: 11.00

PREVIOUS TRANS. NO. (If any):

SPECIFICATION SEC. NO. (Cover only one section with each transmittal): 02219

PROJECT TITLE AND LOCATION: Rio Grande Floodway (Cuchillo Dam), Truth or Consequences, NM

a. ITEM NO.	b. DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.)	c. MFG. OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction No. 8)	d. NO. OF COPIES	e. CONTRACT REFERENCE DOCUMENT: SPEC. PARA. NO.	f. CONTRACT REFERENCE DOCUMENT: DRAWING SHEET NO.	g. VARIATION (See instruction No. 6)	h. FOR C E USE CODE
1	Wire Mesh	Cert.	4	10.2			A

U.S. ARMY ENGINEER DISTRICT, ALBUQUERQUE CORPS OF ENGINEERS
CERTIFIED FOR APPROVAL AS INDICATED BELOW

A - APPROVED AS SUBMITTED
B - APPROVED, EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEET(S). RESUBMISSION NOT REQUIRED
C - APPROVED EXCEPT AS NOTED ON DRAWINGS. REFER TO ATTACHED SHEET. RESUBMISSION REQUIRED
D - ...
E - DISAPPROVED ...
F - ...
G - ...
NOTE: ...

SIGNATURE [signature] 7 MAR 90

REMARKS

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

Michael B. Bee [signature]
NAME AND SIGNATURE OF CONTRACTOR

Section II — APPROVAL ACTION

INCLOSURES RETURNED (List by Item No.)

NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY: [signature]
~~AUTHORIZED REPRESENTATIVE~~
OF THE CONTRACTING OFFICER

DATE: 07 MAR 1990

ENG FORM 4025, Oct 84 (ER 415-1-10) EDITION OF JUL 81 IS OBSOLETE. (Proponent: DAEN-ECC-Q) SHEET ___ OF ___

U.S. GOVERNMENT PRINTING OFFICE-1984-457-871/28020

AMERICAN FENCE COMPANY, INC.

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DEER VALLEY ARIZONA
MESA ARIZONA
TUCSON ARIZONA
SHOWLOW ARIZONA
PRESCOTT ARIZONA
YUMA ARIZONA
SAN MARCOS CALIFORNIA
BAKERSFIELD CALIFORNIA
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SANTEE CALIFORNIA
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HILO, HAWAII
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KONA, HAWAII
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ODESSA, TEXAS
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KANSAS CITY MISSOURI
ALBUQUERQUE, NEW MEXICO
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9634 2ND N.W. • ALBUQUERQUE, NEW MEXICO • TELEPHONE 897-3103

PCL CONSTRUCTION
P.O. BOX 2270
TRUTH OR CONSEQUENCES, NM 87901

Non restrictive chain link fence specification

Materials
Fence fabric shall be new and free of defects, from recognizied and reputable manufacturers, unless otherwise specified. Materials will be hot dipped galvanized with zinc coating measured inn accordance with ASTM A-90. Materials shall be American -made and certified by the manufacturer in accordance with the Buy-American Act of April,1984.Fabric shall be 2" mesh, 11 gauge, hot dipped galvanized.

REFERENCES
RR-F-191/1C Chain Link Fence Fabric

Contractor's Rock Bolt Information

Recd 8 Jan 90

PCL

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

December 22, 1989

Serial Letter No.: 090/02219/10.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Rock Bolts

Gentlemen:

Pursuant to Technical Provision 02219, Paragraph 10.1, titled, "Rock Bolts", the following information is herewith transmitted in four (4) copies, to the contracting officer for review:

1. Manufacturers written installation procedure for rock bolts
2. Drawing IB-JR-1124 showing rock bolt installation
3. Technical data on 1-inch diameter rock bolts
4. Drill hole fill chart for anchorage
5. Technical Date on 1-1/2 inch O.D. coupling
6. Technical data on WIL-X non-shrink grout
7. Laboratory certification for WIL-X non-shrink grout
8. Technical data of T72 tension jack
9. Manufacturers data on CG-600 colloidal grout plant

Our rock bolt supplier, Williams Form Engineering Corp., has proposed the use of rock bolts in 15 ft. lengths with a coupling to join two (2) sections of steel bringing the total length to 30 ft. as required by the contract documents. McCaw Drilling and Blasting will be our subcontractor for the installation of the rock bolts.

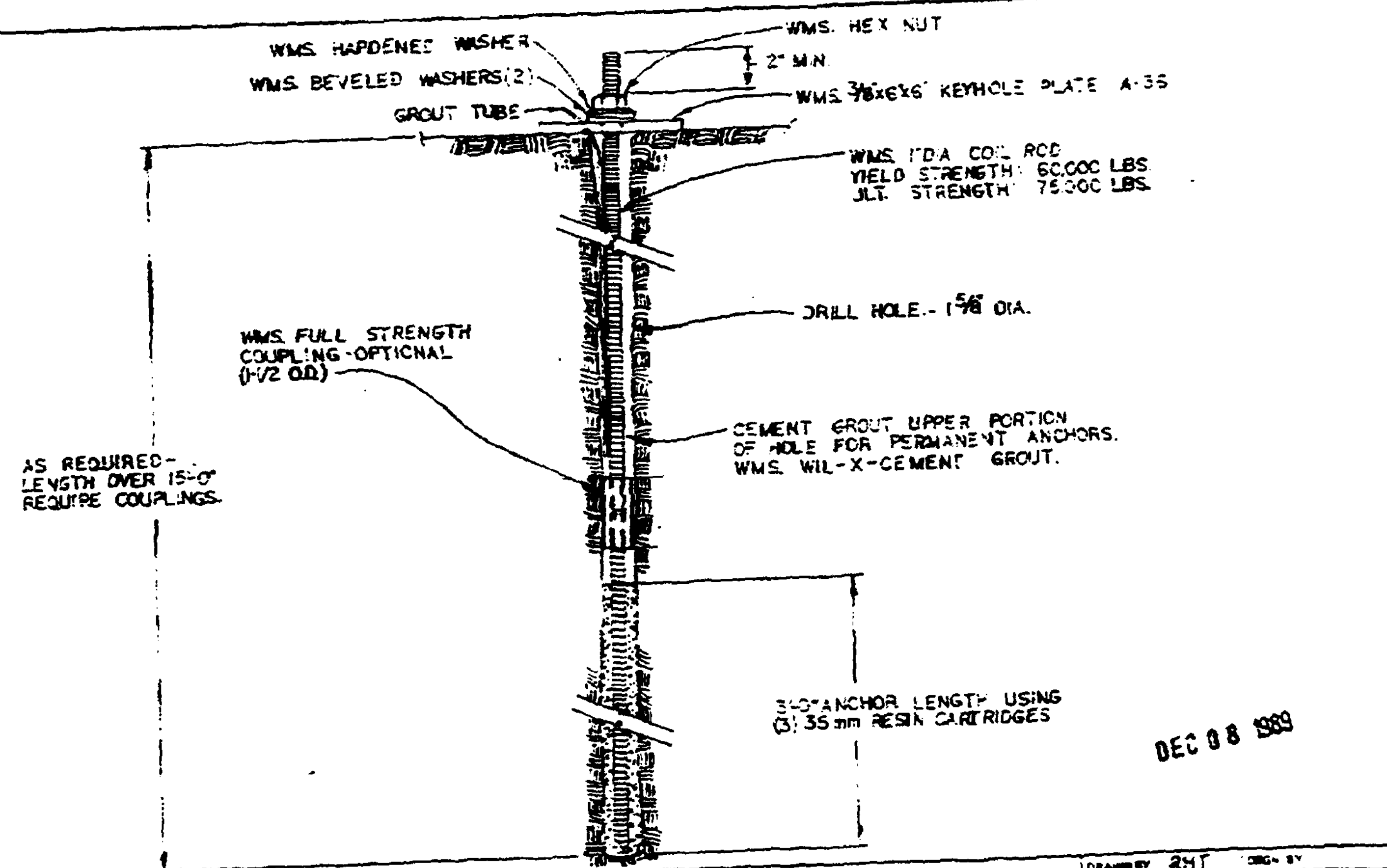
Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

Enclosure

P.O. Box 2270, Truth or Consequences, N.M. 87901 Telephone 505-743-7834 Rapidfax 505-743-7836



DEC 08 1989

WILLIAMS FORM ENGINEERING CORP.

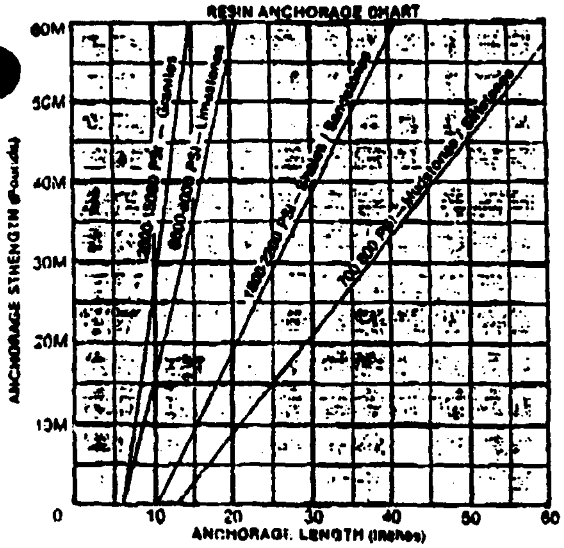
CUSTOMER	PCL CIVIL CONSTRUCTION INC.
PROJECT	1" ANCHOR BOLT WITH OPTIONAL COUPLING
DRAWN BY	RHT
SCALE	1/4" = 1"
DATE	12-8-89
SHEET No	OF 1
PRINT No	IB-JR-1124

INSTALLATION PROCEDURE

- Drill 1-5/8" diameter hole to a depth 2" less than overall rod length to be used. Use rotary percussive equipment.
- Clean hole of dust and debris using high pressure air.
- Insert proper number of 35mm cartridges to bottom of hole. Precautions should be taken to prevent bursting.
- Insert bar and rotate 200-250 RPM through cartridges. Bar should spin for 20-30 seconds after full insertion and reach a minimum of 75 revolutions.
- Installation of rod through resin cartridges should be completed within 6 hours of drilling of hole.
- Place plate, (2) bevel washers, hardened washer and hex nut on bar and position bar in center of hole until full cure of resin.
- Attach test jack assembly to top of bolt and tension to required load not to exceed 37,500 lbs.
- Tighten nut against plate using proper wrench and release jack pressure. Then remove jack.
- Cement grouting of top portion of hole to be done on permanent bolts. Insert grout tube thru keyhole in plate to top of resin elevation. Inject grout at steady flow thru tube to fill hole and slowly extract tube. Top up hole as necessary.

In addition to the above procedure, all requirements set forth in the job specifications are to be followed.

PO BOX 7389 · GRAND RAPIDS, MICHIGAN 49510 · (616) 482-3107 · TELEX (4) 228418 · FAX (616) 482-4083



When fully cured, the resin is stronger than rock and most other materials into which it is likely to be used. Please refer to the following test data which is based on our standard resin cartridge. WILLIAMS FORM can supply higher or lower resin strengths to suit the application. Please contact a WILLIAMS representative for further information.

Uniaxial Compressive Strength	103.33N/mm^2 (15,000 lb/in^2)
Tensile Strength (beam test)	22.1N/mm^2 (3,200 lb/in^2)
Unconfined Shear Strength	52N/mm^2 (7,500 psi)

This chart is intended as a guide for on site trials which will establish the working specifications in the actual ground conditions.

DRILL HOLE FILL CHART — (Per cartridge)

	Imperial	Metric	CARTRIDGE SIZES: Diameter by standard length 300 mm or 12 inches															
			[illegible]	[illegible] (20mm)		[illegible] (23mm)		1-1/4" (32mm)			1-3/8" (35mm)			[illegible] (40mm)			1-3/4" (45mm)	
BOLT DIAMETER REBAR SIZES ASTM A 615 GRADE 60	No. 6 3/4"	20mm	20" (508)	15" (381)	12" (305)	14" (356)	12" (305)											
	No. 7 7/8"			21" (533)	16" (406)	18" (457)	14" (356)	14" (356)										
	No. 8 1"	25mm					21" (533)	18" (457)	13" (330)		15" (381)	12" (305)						
	No. 9 1-1/8"								16" (406)	12" (305)	20" (508)	14" (356)		14" (356)	12" (305)			
		30mm							19" (483)	13" (330)	23" (584)	15" (381)	12" (305)	15" (381)	12" (305)			
	No. 10 1-1/4"									16" (406)		19" (483)	13" (330)	17" (432)	13" (330)			
	No. 11 1-3/8"	35mm											18" (457)	21" (533)	16" (381)	12" (305)	16" (406)	
	No. 14 1-3/4"	45mm														22" (559)		16" (406)
ALL-THREAD ... ASTM A 722	1" Nom. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16" [illegible]	[illegible]	18" (457)	13" (330)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1-1/4" Nom. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18" (457)	23" (584)	16" (406)	12" (305)	15" (381)	
	1-3/8" Nom. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19" (483)	14" (356)	17" (432)	12" (305)
DRILL HOLE DIAMETER			(25mm) 1"	(28) 1-1/8"	(30) 1-3/16"	(30) 1-3/16"	(32) 1-1/4"	(35) 1-3/8"	(38) 1-1/2"	(41) 1-5/8"	(38) 1-1/2"	(41) 1-5/8"	(44) 1-3/4"	(44) 1-3/4"	(48) 1-7/8"	(51) 2"	(51) 2"	(57) 2-1/4"

SET TIMES AVAILABLE:

- Two-Four Minutes — This is a standard gel time and used when insertion and rapid mixing can be achieved.
- Fifteen-Thirty — This is normally used with WILLIAMS fast gelling cartridges to ensure complete grouting when pre-tensioned fully grouted bolts are required.

ORDERING INFORMATION: WILLIAMS resin cartridges are ordered by size and type. Stock sizes manufactured can be found in the usage chart. The size of the cartridge required is the ordering part number. The Type refers to the gel time required.

EXAMPLE: S9R-32-305-02-04

dia. length gel time (of cartridge)

HIGH TENSILE STEEL Williams B1S High Tensile Tie Rods, B2S Pigtail Anchors, B7S and B8S Continuous Thread Rod					
Thread Dia.	Thread Pitch		Safe Working Load	Maximum Working Load to elastic limit	Ultimate Strength
Inches / mm	Coil Thd.	V Thd.	Lbs. / Kn	Lbs. / Kn	Lbs. / Kn
5/16" / 8	—	18 DL	4,160 / 18.5	5,000 / 22.2	6,250 / 27.8
3/8" / 10	8	16 NC	6,500 / 28.9	7,500 / 33.4	9,800 / 43.6
1/2" / 13	6	13 NC	12,000 / 53.4	13,000 / 57.8	18,000 / 80.1
5/8" / 16	4-1/2	11 NC	16,660 / 74.1	21,000 / 93.3	25,000 / 111.2
3/4" / 19	4-1/2	10NC	25,300 / 112.5	30,000 / 133.5	38,000 / 169.0
7/8" / 22	4-1/2	9NC	38,660 / 172.0	46,000 / 204.6	58,000 / 258.0
1" / 25	3-1/2	8 NC	50,000 / 224.4	60,000 / 266.8	75,000 / 333.5
1-1/8" / 29	3-1/2	7 NC	60,000 / 266.9	72,000 / 320.3	90,000 / 400.4
1-1/4" / 32	3-1/2	7 NC	80,000 / 355.9	90,000 / 400.4	120,000 / 533.7
1-3/8" / 35	—	8 UN	90,000 / 400.4	110,000 / 489.2	135,000 / 600.4
1-1/2" / 38	3-1/2	6 NC	95,000 / 422.6	112,000 / 498.2	140,000 / 622.8
2" / 51	—	8 UN	206,650 / 919.3	255,000 / 1134.3	310,000 / 1379.0

*Based on approximate 1.5 to 1 Safety Factor

H4R NEOPRENE WATER SEAL WASHER

Designed to prevent water leakage along the tie rod. Available in tie-rod sizes 1/2"-1-1/4". Special sizes available upon request.

[illegible]	H4R Neoprene [illegible]	[illegible]
1/2"	1"	[illegible]
5/8"	[illegible]	[illegible]
3/4"	1-1/4"	[illegible]
7/8"	1-3/8"	[illegible]
1"	1-1/2"	[illegible]
1-1/8"	1-5/8"	[illegible]
1-1/4"	1-7/8"	[illegible]

B7G CONTINUOUS MILD STEEL COIL ROD

WILLIAMS B7G Coil Rod is manufactured in mild steel. It is available in 3/4", 1" and 1-1/4" diameters. Standard lengths: 10'0". Stocked in all diameters. See chart below for strengths.

B7G Mild Steel Continuous Coil Thread Rod		
Dia. Pitch	Working Load*	Ultimate Strength
3/4 - 4-1/2	12,000 lbs.	18,000 lbs.
1 - 3-1/2	24,000 lbs.	36,000 lbs.
1-1/4 - 3-1/2	36,000 lbs.	54,000 lbs.

Based on 1.5 to 1 Safety Factor
Mild steel 10' standard length.

WILLIAMS

Coil thread Couplings

Rod Diameter (Inches)	O.D.	Length	Safe Working Load (1.5:1 S.F.)	Ultimate Strength
3/8"-8	3/4"	1-1/2"	7,900 lbs.	11,900 lbs.
1/2"-6	3/4"	2"	17,000 lbs.	26,000 lbs.
5/8"-4-1/2	1"	2-1/2"	26,000 lbs.	39,000 lbs.
3/4"-4-1/2	1-1/8"	3"	31,000 lbs.	46,000 lbs.
7/8"-4-1/2	1-1/4"	3-1/2"	39,000 lbs.	58,000 lbs
1"-3-1/2	1-1/2"	4"	54,000 lbs.	81,000 lbs.
1-1/8"-3-1/2	1-5/8"	4-1/2"	61,000 lbs.	91,000 lbs.
1-1/4"-3-1/2	1-7/8"	5"	83,000 lbs.	125,000 lbs.
1-1/2"-3-1/2	2-1/4"	6"	99,800 lbs.	149,000 lbs.

WHEN ORDERING COUPLINGS PLEASE SPECIFY:

- Type - C1T or C2T etc.
- Rod Diameter or Diameters
- Thread Type or Types

S5Z WIL-X CEMENT GROUT (B)

CONFORMS TO ASTM C 845-76 T

Available in
- 5 gallon
- resealable,
- moisture proof,
- polypropylene pails

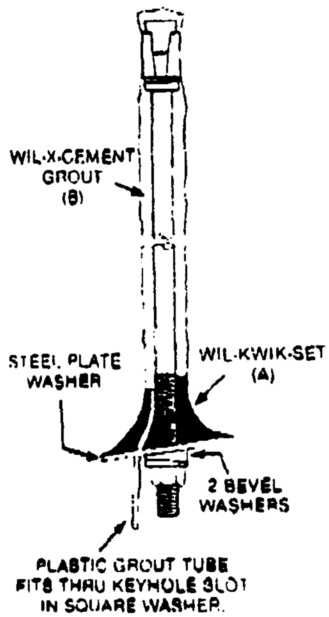
Wil-X is chemically compensated for shrinkage. It has a high bond value and is crack resistant for permanent installations and more durable grout. Because it is a cement-grout, it is non-explosive and has a long shelf life when kept dry.

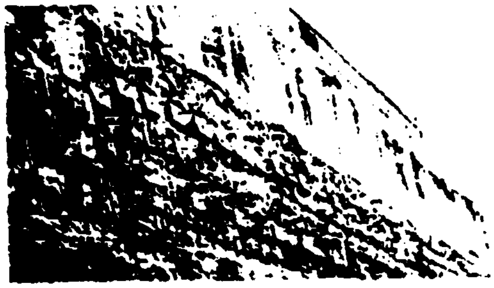
Wil-X may be used to build up leveling pads by simply mixing with sand or pea gravel. This mixture should not be run through the grout pump.

SETTING TIME: Gilmore Needles (ASTM C 266). Initial set 45 minutes; final set 10 hours.

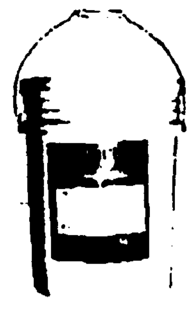
COMPARATIVE COMPRESSIVE STRENGTH TEST IN PSI (modified ASTM C 109)* 3 days in moist air/4 days in water 2800.) Actual strengths as mixed according to Williams instructions range from 6000 to 9000 PSI depending on water content.

*Copy of ASTM Modification available upon request.





S4Z WIL-KWIK-SET (A)



Available in:
- 5 gallon,
- resealable
- moisture proof,
- polypropylene pails

A fast setting cement with an initial set time from 3 to 6 minutes. It's primary use is to hold the de-air tube in place and seal off the entrance to the drill hole around the Williams Hollow Core Rock Bolt. Mix Wil-Kwik-Set with water until a soft paste is obtained which can be formed into a 4" to 6" ball. Place grout tube in drill hole next to rock and press ball of Wil-Kwik-Set around bolt and tube, making sure entire drill hole is closed off. Place bearing plate over end of rock bolt and grout tube and press firmly against rock and Wil-Kwik-Set until plate is well seated against rock. Bolt may immediately be tensioned and grouted with Wil-X-Cement grout. New Wil-Kwik-Set is also recommended for patching leaks, cracks, cone and tie holes or calking around pipes in masonry or concrete walls or floors.

SOUTHWESTERN PORTLAND CEMENT COMPANY

EASTERN DIVISION • 506 EAST XENIA DRIVE • P.O. BOX 191 • FAIRBORN, OHIO 45324
513-878-8051 • 800-762-0340 (OHIO)

CERTIFICATION

February 22, 1989

Consignee:
Williams Form Engineering Corporation
1501 Madison Ave., SE
P. O. Box 7389
Grand Rapids, Michigan 49510

Carrier No.	No. Tons	Date Shipped

~~Williams Form Engineering Corp.~~
This ~~Quality Assurance document has been received and deemed acceptable as noted.~~

by: ________ on ________
~~Quality Assurance Mgr~~ ~~(date)~~

checked by: ~~CHEMICAL DATA~~

Expansive Cement, Type E-1(K)**

A.S.T.M. Designation C845-87

Federal Specification --

PHYSICAL DATA

Specific Surface:
- (Blaine) Sq. Cm. per Gram 4020
- (Wagner) Sq. Cm. per Gram --

Soundness:
- Autoclave Expansion * %
- Restrained Expansion; 7 days 0.075 %

Time of Setting:

	Hrs.	Min.
Gillmore Initial	1	00
Gillmore Final	3	15
Vicat Initial	-	--
Vicat Modified	1	42

Air Entrainment, % by Volume 8.6

Compressive Strength (2-inch Mortar Cubes)	Lbs. per Sq. In.
1-Day	2500
3-Days	3630
7-Days	4300
28-Days	--

Chemical Composition:	Percent
Silicon Dioxide (SiO_2)	18.7
Aluminium Oxide (Al_2O_3)	5.5
Ferric Oxide (Fe_2O_3)	2.9
Magnesium Oxide (MgO)	4.5
Sulfur Trioxide (SO_3)	4.8
Loss on Ignition	1.6
Insoluble Residue	0.18
Tricalcium Silicate	*
Tricalcium Aluminate	*
Alkalies, Eqv. Na_2O	*

*Not required by specification.

We hereby certify that the cement contained in this shipment conforms to all of the Standard requirements for Portland Cement in the above Specification, for the type specified.

Subscribed and sworn to before me
this 22nd day of February 1989

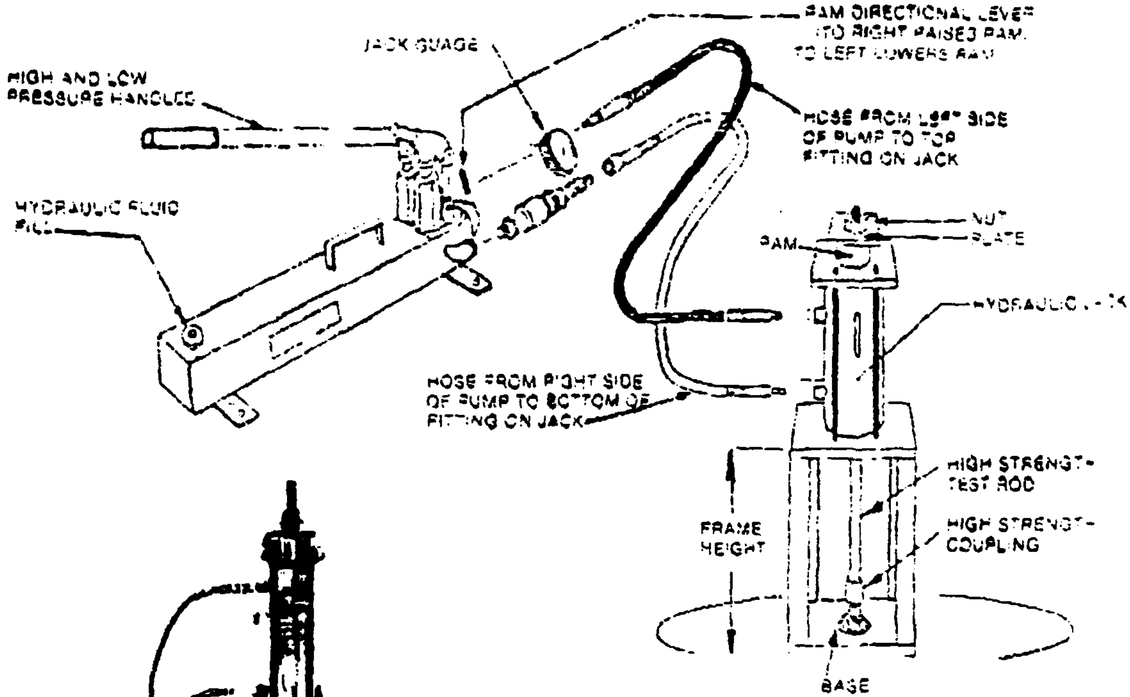
Joyce A. Smith
Joyce A. Smith, Notary Public
In and for the State of Ohio
My commission expires Sept. 28, 1990
Recorded in Greene County

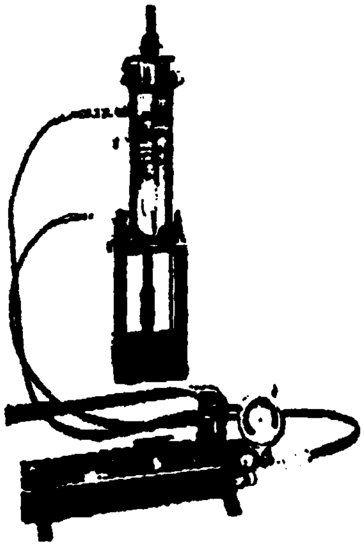
SOUTHWESTERN PORTLAND CEMENT COMPANY
EASTERN DIVISION FAIRBORN, OHIO

By Karl S. Getson
Karl S. Getson, Chief Chemist
Authorized Company Representative

**Trade name: Williams Wil-X Cement Grout

PLANTS • FAIRBORN, OHIO • LEAMINGTON UTAH • LYONS, COLORADO • ODESSA TEXAS • VICTORVILLE, CALIFORNIA





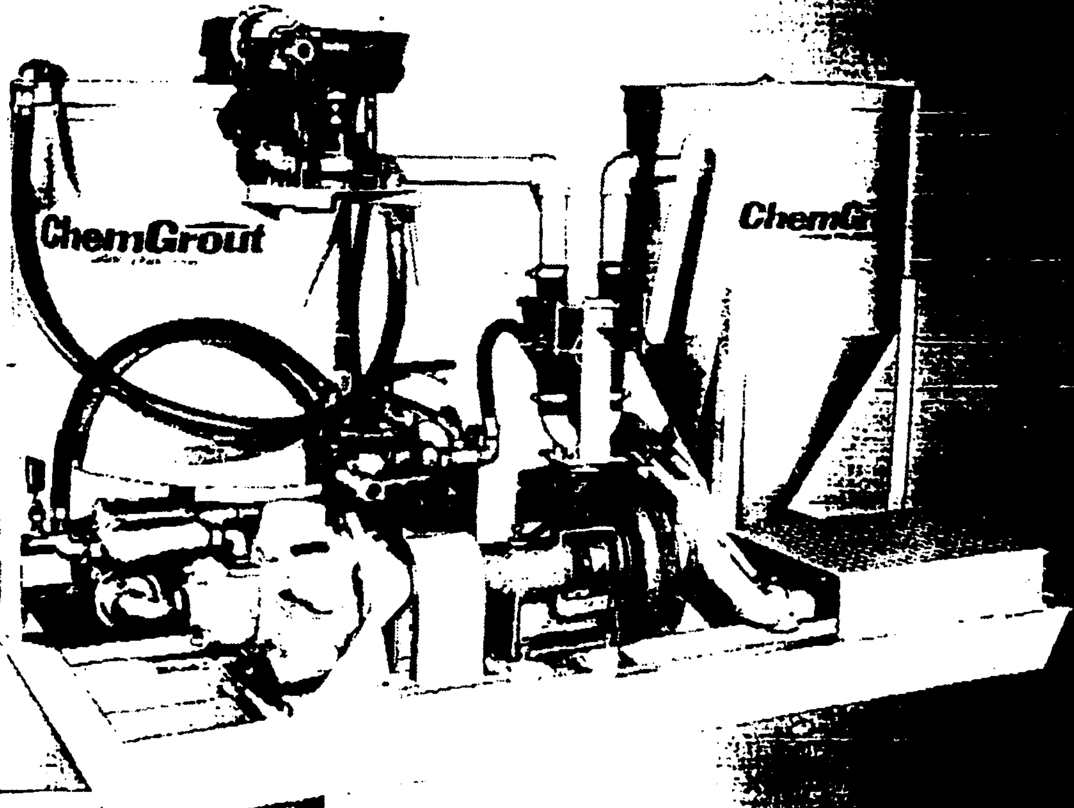
T7Z HYDRAULIC JACK

Used for testing and pre-stressing rock and anchor bolts. Available with up to 3-1/8" center hole. Unit comes with: Ram, Pump, Gauge, Hoses, Jack Stand, High Strength Coupling, High Strength Test Rod, Plate and Hex Nut.

JACK CAPACITY (TONS)	JACK HEIGHT	BASE SIZE	RAM TRAVEL	MINIMUM TOTAL HEIGHT OF RAM AND FRAME	MAX TEST ROD SIZE	RAM AREA IN SQ. IN.	APPROX. TOTAL WT. OF RAM & FRAME
30 w/Hand pump	5"	8"x8"	2"	17"	1"x18"	6.53	60 lbs.
60 w/Hand pump	9-5/8"	8"x8"	3"	26"	1-3/8"x27"	13.75	122 lbs.
60 w/Hand pump	15-1/2"	9"x9"	10"	35"	1-3/8"x36"	13.75	225 lbs.
100 w/air powered pump	18"	9"x9"	10"	36"	2"x37"	21.20	243 lbs.
150 w/air powered pump	22-1/2"	12"x12"	12"	41"	2"x42"	40.89	610 lbs.

CG-600 Colloidal Grout Plant

Complete colloidal mixing and pumping plant for high volume cement grouting



- Two large tanks permit high production rates
- High speed colloidal mixing pump thoroughly wets all particles
- Non-pulsing, positive displacement pump
- Unit can be cleaned in less than 10 minutes
- All controls positioned for operation by one man

ChemGrout

EE COMPLETE
ECIFICATIO

CG-600 Specifications

Pump	
Type	non-pulsing positive displacement
Production	maximum 20 gpm @ 225 psi
	optional pump to 500 psi
	maximum 12 gpm production rate
Tanks	one 13 C.F. cone bottom
	one 13 C.F. slope bottom
Mixing Pump	60 psi, homogenizing,
	diffuser-type centrifugal
Size	98"L × 48"W × 63"H
Weight	1800 lbs

Equipped with heavy-duty industrial water meter resettable to zero with cumulative totalizer

Not suitable for sanded grouts.

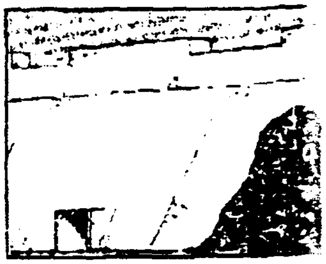
For sanded grouts use model CG-500

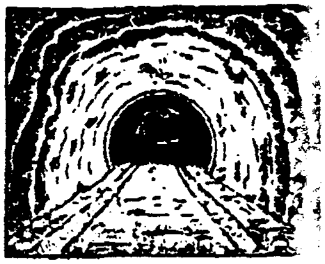
Drive Power		
Type	Power	Quantity
Air	100 psi	450 C.F./M.
Electric	230/460V	78/39 amps
Hydraulic	1800 psi	25 gpm

Specifications are subject to change without notice

Applications

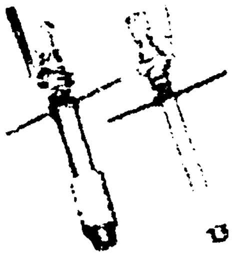
Dams
Tunnels
Shafts
Tendon grouting
Bentonite mixing
& pumping





Accessories

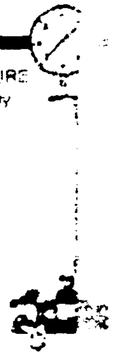
MECHANICAL SURFACE PACKERS
1½" to 3" diameters
12", 24", 36" lengths.
With shut off valve and
quick-disconnect coupling
Specify length and diameter



GROUT HOSE. Heavy-duty, light-weight.
Equipped with quick disconnect fittings
Dia. 1", 1¼", 1½" — 25' & 50' lengths

DEEP PACKERS. Tigre Tierra type inflatable
[illegible]

PROTECTED PRESSURE GAUGES. Protected by one foot air column, in-line mounting with snap fittings supplied



ChemGrout

"Experience in Grouting for 25 Years"

CHEMGROUT, INC. • [illegible] • [illegible] • Tulsa, RCA 297242 • Fax [illegible]

PCL

19 APR REC'D

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

April 19, 1990

Serial Letter No.: 247/02219/10.1.1

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Calibration of Rock Bolt Test Jack

Gentlemen:

Reference is made to Technical Provision 02219, Paragraph 10.1.1, which states "Rock bolt tensioning shall be by an approved calibrated center hole hydraulic jack". Enclosed please find a letter from the Williams Form Engineering Corporation which states that the 30-ton test jack on this project was calibrated on April 5, 1990.

Should any questions arise concerning the above, please contact the undersigned at this office.

Sincerely,

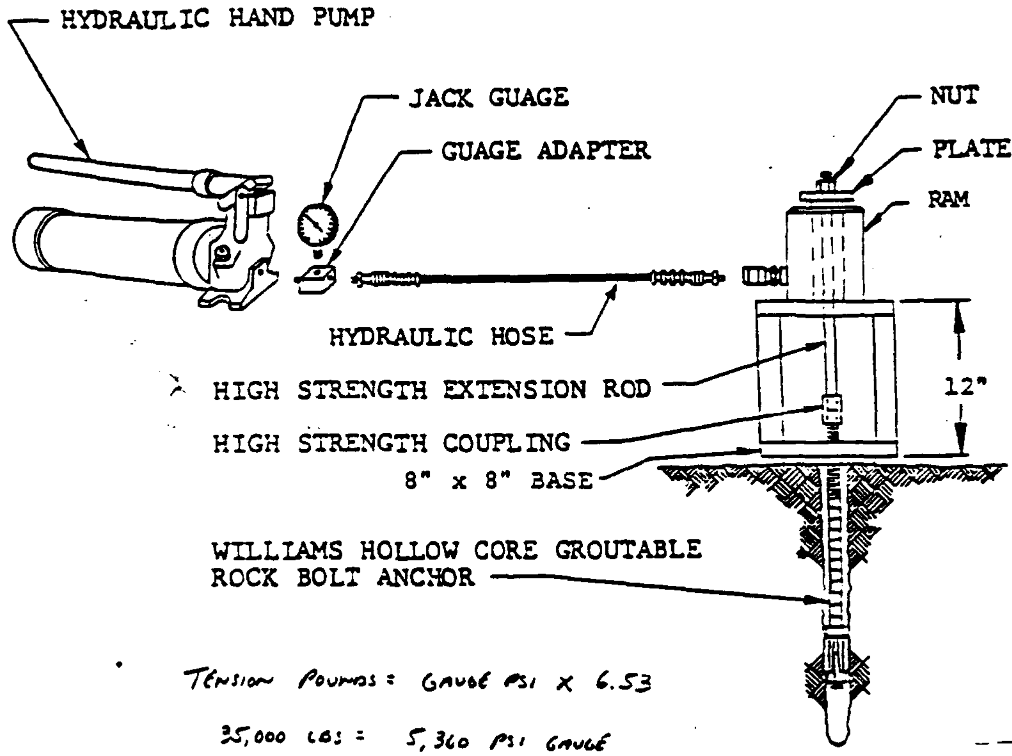
Thomas R. O'Donnell
Project Engineer

TRO:deo

WILLIAMS FORM TEST JACK

(STANDARD SIZES SHOWN ONLY)

LOAD OR SPRING RETURN



Tension Pounds = Gauge PSI x 6.53

35,000 LBS = 5,360 PSI Gauge

TO OBTAIN TENSION IN POUNDS, MULTIPLY P.S.I. BY RAM AREA SHOWN NEAR TOP OF RAM.

WILLIAMS FORM ENGINEERING CORP. P.O. BOX 7343 • GRAND RAPIDS, MICH. 49510 (616) 452-3107 • TX. 22-6416	DRAWN BY *DHT* / SCALE ——— / DATE 5-2-89
	Rev. No. 869-3

WILLIAMS
FORM ENGINEERING CORP.

April 17, 1990

Attn: Tom O'Donnell
P.C.L. Civil Constructors
P O Box 2270
Truth or Consequences, NM 87901

Ref: 30 ton test jack complete, rental
Your purchase order no. P37020
Cuchillo Dam Site, Cuchillo, NM

Gentlemen:

This is to certify that gauges used on Williams test jacks are checked against a master gauge that is calibrated and tested on a regular basis. The gauge shipped with your jack was checked against the master gauge the day of shipment, April 5, 1990.

Sincerely,

Charles Miller
Quality Assurance Manager

sds

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE 10 JAN 1990

(Read instructions on the reverse side prior to initiating this form)

DATE: January 5, 1990

☒ NEW SUBMITTAL
☐ RESUBMITTAL

Section I — REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the contractor)

TO: Construction Branch
USAED Albuquerque
P.O. Box 1580
Albuquerque, NM 87103-1580

FROM: PCL Civil Constructors, Inc.
P.O. Box 2270
Truth or Consequences, NM 87901

CONTRACT NO.: DACW-47-89-C-0056

TRANSMITTAL NO.: 7.00

PREVIOUS TRANS. NO. (If any):

SPECIFICATION SEC. NO. (Cover only one section with each transmittal): 02219

PROJECT TITLE AND LOCATION: Rio Grande Floodway (Cuchillo Dam), Truth or Consequences, NM

ITEM NO. a.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.) b.	MFG. OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction No. 8) c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT: SPEC. PARA. NO. e.	CONTRACT REFERENCE DOCUMENT: DRAWING SHEET NO. f.	VARIATION (See instruction No. 6) g.	FOR C E USE CODE h.
1	Williams Form Engineering - Rock Bolts	Certs	4	10.1			
2	Williams Form Engineering - Rock Bolts	Lab Report	4	10.1			

REMARKS

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

Michael B. Beel
NAME AND SIGNATURE OF CONTRACTOR

Section II — APPROVAL ACTION

INCLOSURES RETURNED (List by Item No.)

NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY

DATE

ENG FORM 4025, Oct 84 (ER 415-1-10) EDITION OF JUL 81 IS OBSOLETE. (Proponent: DAEN-ECC-Q) SHEET ___ OF ___

U.S. GOVERNMENT PRINTING OFFICE-1984-457-871/28020

WILLIAMS
FORM ENGINEERING CORP.

December 29, 1989

CERTIFICATE OF CONFORMANCE

Customer: PCL Civil Constructors
P O Box 2270
Truth or Consequences, NM 87901

Project: Cuchillo Dam Project

Purchase Order: No. P-37020
Williams S/O 51750

This is to certify that the material supplied on the above purchase order no. P-37020 meets the requirements of the specifications as stated. We further certify that all work performed was done in accordance with Williams Form Engineering Corporation manufacturing standards.

Description of Material

Bolts: 1"-3-1/2 dia. Williams S.H.T. Coil All Thread Rod X 15'0" long. Conforms to ASTM A-108 and ASTM A 663-82. Heat No. J43674 (copy attached).

Grout: Wil-X-Cement Grout in 55 lb pails. Conforms to ASTM C 845-80 and CRD-C-621.

Charles M. Miller

Charles M. Miller
Quality Assurance Manager

Williams Form Engineering Corporation

Bruce A. Kesler

Bruce A. Kesler
Notary Public, Kent County, MI
My Commission Expires: May 2, 1993

ACTION CODE RECOMMENDED				
A	B	C	D	E

Checked by:

Date: 1/17/90

*** WALKER WIRE & STEEL COMPANY ***
ROYAL WIRE DIVISION
660 East Ten Mile Road
Ferndale, Michigan 48220

-4800
-564-5849
elex:
797193 WWS
Easylinc Mailbox:
62905073

Order No. 49072
Acct. No. 1983
Salesman# 12

S H I P P E R

Sold To: WILLIAMS FORM
ENGINEERING COMPANY
1501 MADISON SE
GRAND RAPIDS, MI 49509
Attn:
Phone: 616-452-3107

Ship To: WILLIAMS FORM ENGINEERIN
1448 COLLEGE AVE. SE
GRAND RAPIDS, MI 49507

Williams Form Engineering Corp.
This Quality Assurance document has been reviewed and deemed acceptable as noted:

Austin Miller 7/10/89
Quality Assurance Mgr (date)
checked by: ______

Order Date 05/09/89
Terms 1/2 10 N
Ship Via ROYAL/TOM
F.O.B. PREPAID
Date Shipped 06/27/89
Shipment No. 1

NO.	Ordered		Shipped
1	8000 lbs.	1541 INDUSTRIAL QUALITY WIRE F6 SK 0.892 +0.0020 / -0.0020 STRAIGHT & CUT TO 240.000 +0.000 /-0.000 YOUR PART # A1S-C8 YOUR PO NUMBER: 4301	8767 lbs. 206 Pcs.

CERTIFICATION OF INSPECTION AND TEST

CHEMICAL ANALYSIS FOR Heat #: J43674

C:	.420	Ni:	.073
Mn:	1.570	Cr:	.095
P:	.025	Mo:	.024
S:	.017	Pb:	
Si:	.300	B:	
Cu:	.2000	Al:	

Other

Ultimate Strength: 127,036
Yield Strength: 107,981
Elongation: 22.1%
Reduction of Area: 41.1%

Walker Wire & Steel Company hereby certifies that the above materials have been inspected and tested in accordance with the methods prescribed in the applicable specifications and the results of such inspection and tests are as shown above. For properties or characteristics for which no methods of inspeecting or testing are prescribed by said specifications, the standard inspection and testing practices of Walker Wire & Steel Company have been applied. Based upon such inspection and tests the above materials have been approved as fulfilling the requirements of said specifications.

WALKER WIRE AND STEEL COMPANY
by [signature]

State of Michigan/Illinois -
County of Oakland/Livingston
On this 27th day of June AD, 1989, before me, a Notary Public in and for said state and county, personally appeared the above who, being duly sworn according to law, did depose and dpose and say that she is duly authorized to execute the foregoing certificate on behalf of Walker Wire and Steel Company and that the facts there in contained are true and correct to the best of her/his knowledge, information and belief.

Laurence A. Moor
Notary Public
LAWRENCE A. MOOR
Notary Public, Macomb County, Michigan
My Commission Expires ...

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE
(Read instructions on the reverse side prior to initiating this form)

10 JAN 1990

DATE: January 5, 1990

☒ NEW SUBMITTAL
☐ RESUBMITTAL

Section I — REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the contractor)

TO: Construction Branch
USAED Albuquerque
P.O. Box 1580
Albuquerque, NM 87103-1580

FROM: PCL Civil Constructors, Inc.
P.O. Box 2270
Truth or Consequences, NM 87901

CONTRACT NO.: DACW-47-89-C-0056

TRANSMITTAL NO.: 7.00

PREVIOUS TRANS. NO. (If any):

SPECIFICATION SEC. NO. (Cover only one section with each transmittal): 02219

PROJECT TITLE AND LOCATION: Rio Grande Floodway (Cuchillo Dam), Truth or Consequences, NM

ITEM NO. a.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.) b.	MFG. OR CONTR. CAT., CURVE DRAWING OR BROCHURE NO. (See instruction No. 8) c.	NO. OF COPIES d.	CONTRACT REFERENCE DOCUMENT: SPEC. PARA. NO. e.	CONTRACT REFERENCE DOCUMENT: DRAWING SHEET NO. f.	VARIATION (See instruction No. 6) g.	FOR C E USE CODE h.
1	Williams Form Engineering - Rock Bolts	Certs	4	10.1			A
2	Williams Form Engineering - Rock Bolts	Lab Report	4	10.1			A

U.S. ARMY ENGINEER DISTRICT, ALBUQUERQUE CORPS OF ENGINEERS
CERTIFIED FOR APPROVAL AS INDICATED BELOW

A - APPROVED AS SUBMITTED
B - APPROVED, EXCEPT AS NOTED ON DRAWINGS AND/OR ATTACHED SHEET(S). RESUBMISSION NOT REQUIRED
C - APPROVED EXCEPT AS NOTED ON DRAWINGS. REFER TO ATTACHED SHEET. RESUBMISSION REQUIRED
D - [illegible]
E - DISAPPROVED. SEE [illegible] SHEET.
F - RECEIPT [illegible]
G - OTHER [illegible]

NOTE: ITEMS APPROVED AS TO GENERAL LAYOUT ONLY. DIMENSIONS & QUANTITIES [illegible] CONTRACTOR [illegible] SHALL BE [illegible] CORRECTIONS. [illegible]

SIGNATURE: Mike Beyer 23 Jan '90

REMARKS

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

Michael B. Beel
NAME AND SIGNATURE OF CONTRACTOR

Section II — APPROVAL ACTION

INCLOSURES RETURNED (List by Item No.)

NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY: Mike Beyer

DATE: 23 Jan '90

ENG FORM 4025, Oct 84 (ER 415-1-10) EDITION OF JUL 81 IS OBSOLETE. (Proponent: DAEN-ECC-Q) SHEET ___ OF ___

U.S. GOVERNMENT PRINTING OFFICE-1984-457-871/28020

Page# 2 of 2

+++ WALKER WIRE & STEEL COMPANY +++
ROYAL WIRE DIVISION
660 East Ten Mile Road
Ferndale, Michigan 48220

Phone:
313-399-4800
313-564-5849
Telex:
797193 WWS
Easylinc Mailbox:
62905073

Order No. [illegible]
Acct. No. [illegible]
Salesman# [illegible]

SHIPPER

Sold To: WILLIAMS FORM
ENGINEERING COMPANY
1501 MADISON SE
GRAND RAPIDS, MI 49509
Attn:
Phone: 616-452-3107

Ship To: WILLIAMS FORM ENGINEERIN
1448 COLLEGE AVE. SE

GRAND RAPIDS, MI 49507

Williams Form Engineering Corp.
This Quality Assurance document has been reviewed and deemed acceptable as noted:

Aneles Miller on 7/10/89
Quality Assurance Mgr (date)
checked by: ______________

Order Date 05/[illegible]/89
Terms 1/2 10 N
Ship Via ROYAL/TOM
F.O.B. PREPAID
Date Shipped 06/27/89
Shipment No. 1

NO.	Ordered		Shipped

*** CERTIFICATION OF INSPECTION AND TEST ***

1 8000 lbs. 1541 INDUSTRIAL QUALITY WIRE FG SK — 8767 lbs.
0.992 +0.0020 / -0.0020 STRAIGHT & CUT TO 240.000 +0.000 /-0.000 YOUR PART # A1S-C8 — 296 Pcs.
YOUR PO NUMBER: 4301

CHEMICAL ANALYSIS FOR Heat #: J43674

C:	.420	Ni:	.073
Mn:	1.570	Cr:	.095
P:	.025	Mo:	.024
S:	.017	Pb:	
Si:	.300	B:	
Cu:	.2000	Al:	

Other

Ultimate Strength: 127,036
Yield Strength: 107,981
Elongation: 22.1%
Reduction of Area: 41.1%

Walker Wire & Steel Company hereby certifies that the above materials have been inspected and tested in accordance with the methods prescribed in the applicable specifications and the results of such inspection and tests are as shown above. For properties or characteristics for which no methods of inspecting or testing are prescribed by said specifications, the standard inspection and testing practices of Walker Wire & Steel Company have been applied. Based upon such inspection and tests the above materials have been approved as fulfilling the requirements of said specifications.

WALKER WIRE AND STEEL COMPANY

by Judy Kubek

State of Michigan/Illinois -
County of Oakland/Livingston
On this 27th day of June AD, 1989, before me, a Notary Public in and for said state and county, personally appeared the above who, being duly sworn according to law, did depose and dpose and say that she is duly authorized to execute the foregoing certificate on behalf of Walker Wire and Steel Company and that the facts there in contained are true and correct to the best of her/his knowledge, information and belief.

Laurence A. Moor
Notary Public
LAWRENCE A. MOOR
Notary Public, Macomb County, Michigan
My Commission Expires August 24, 1991

WILLIAMS
FORM ENGINEERING CORP.

December 29, 1989

CERTIFICATE OF CONFORMANCE

Customer: PCL Civil Constructors
P O Box 2270
Truth or Consequences, NM 87901

Project: Cuchillo Dam Project

Purchase Order: No. P-37020
Williams S/O 51750

This is to certify that the material supplied on the above purchase order no. P-37020 meets the requirements of the specifications as stated. We further certify that all work performed was done in accordance with Williams Form Engineering Corporation manufacturing standards.

Description of Material

Bolts: 1"-3-1/2 dia. Williams S.H.T. Coil All Thread Rod X 15'0" long. Conforms to ASTM A-108 and ASTM A 663-82. Heat No. J43674 (copy attached).

Grout: Wil-X-Cement Grout in 55 lb pails. Conforms to ASTM C 845-80 and CRD-C-621.

Charles M. Miller

Charles M. Miller
Quality Assurance Manager

Williams Form Engineering Corporation

Bruce A. Kesler

Bruce A. Kesler
Notary Public, Kent County, MI
My Commission Expires: May 2, 1993

PO BOX 7389 · GRAND RAPIDS, MICHIGAN 49510 · (616) 452-3107 · TELEX No. 226416 · FAX (616) 452-4089

APPENDIX G

APPENDIX G

TABLE OF CONTENTS

Description	Page
Contractor's Blasting Proposals & Information	G-1
Selected Blast Reports	G-96
Seismograph Records and Selected Readouts	G-123

Contractor's Blasting Proposals & Information

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

November 9, 1989

Serial Letter No: 023/02219/7

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056
Rio Grande Floodway
T or C Unit, NM

Subject: Blasting Initation System Deviation

Gentlemen:

Reference is made to Section 02219, Paragraph 7.10, Item #3 of the contract documents which states "All blasting shall be initiated with an approved electrical system (sequential timer), and controlled by use of MS delays". PCL Constructors proposes the use of a non-electrical initiation system for our blasting operations which is immune to extraneous electricity. The system will employ a self contained plastic tube containing reactive materials that transmit firing signals to various surface and in-hole MS delays. This proposal is made to increase the safety of our employees at the project site as a non-electrical system can not be initiated by high frequency radio transmissions, or stray electrical energy, flame, friction or impact found in normal conditions. Manufacturers literature for a typical non-electrical system is enclosed for your review.

This proposal is submitted at no additional cost to the government.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

P.O. Box 2270, Truth or Consequences, N.M. 87901 Telephone 505-743-7834 Rapidfax 505-743-7836

Ensign-Bickford

NONEL®

TECHNICAL BULLETIN

Primadets®

NOISELESS TRUNKLINE DELAYS (NTD) LONG LEAD HD NONEL® PRIMADETS® (LLHD)

BLASTING PRODUCTS DIVISION

The Ensign-Bickford company

TOTAL NONELECTRIC SEQUENTIAL BLAST INITIATION FOR USE IN ALL SURFACE BLASTING APPLICATIONS

A NONELECTRIC DELAY SYSTEM SUITED FOR SURFACE COAL MINING, QUARRIES, OPEN PIT MINES AND CONSTRUCTION
The Total Nonel® System serves as an excellent surface trunkline and down-line initiation system for the following reasons:

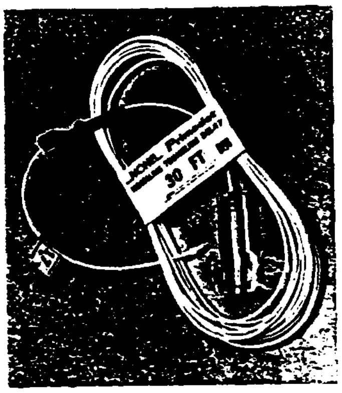
Safe Factory assembly of Nonel components is safer than field cutting and splicing of initiation components. Nonel tube can not be initiated by high frequency radio transmissions, static or stray electrical energy, flame, friction, or impact found in normal mining conditions. However, blasting caps are far more sensitive to these conditions.

Simple-Flexible Nonel components, both the NTD and the LLHD Nonel Primadets®, are factory assembled. They can be readily and simply connected to accommodate both basic and complex blast initiation patterns without complex circuitry.

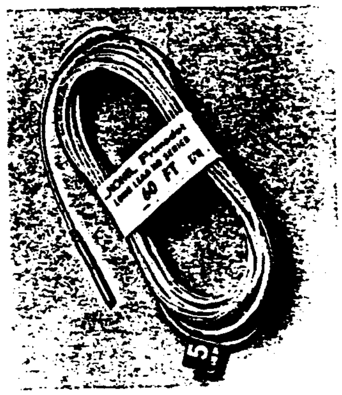
Non-electric Requires no knowledge of electric circuitry. Completely non-electric—no need to instruct blasters on intricacies of electric circuits. No need for elaborate training and retraining of blasters. This is the simplest system available for applications requiring unlimited sequential delays.

Noiseless The Nonel initiation system is quiet. The signal moving through an initiated tube is so quiet that it can be called Noiseless.

Economical The Nonel system allows for a reduced inventory resulting from the elimination of stocking various lengths of a complete delay series.



NOISELESS TRUNKLINE DELAY



LONG LEAD H.D. NONEL PRIMADET

DESCRIPTION OF SYSTEM COMPONENTS

Nonel Primadets are nonelectric blasting caps using Nonel tube as a lead.

NTD units with Bunch Blocks and LLHD Nonels are Nonel Primadets whose lengths, delay times and hardware are suited for use as trunklines and downlines to inhole delays for surface blasting. The NTD and LLHD units are factory assembled with 5 and 3 components respectfully.

NOISELESS TRUNKLINE DELAYS WITH BUNCH BLOCKS

LONG LEAD HD NONEL PRIMADETS

Both the NTD and LLHD Nonel Primadets incorporate the Nonel tube which transmits a noiseless initiation signal from the initiation end to the delay in the output end. Reactive material on the inside of the tube propagates at 6000 feet per second.

The blasting cap has an integral millisecond (MS) delay element which initiates LLHD downlines and outgoing NTD's.

The blasting cap has an integral millisecond delay element. The cap will initiate all commercially available cast boosters and other cap sensitive explosives.

A delay tag indicates the millisecond end to end delay time. The tag is located just below the water tight ultrasonic seal at the end of the Nonel tube.

The Bunch Block connector is made of durable plastic and is designed to hook up LLHD downlines and outgoing NTD's.

LLHD Nonel Primadets utilize the same Nonel tube used for NTD's, however they have an added amount of abrasion resistant plastic. Tensile strength is also increased by this additional plastic. The LLHD tube has adequate physical properties to be used in all mining environments.

"J" Hook*, an inert moveable fitting at the initiation end of the NTD for quick reliable connection to Primacord downlines.

***NOTE:** The "J" Hook is used only when the NTD is to be initiated by Primacord®. See separate bulletin on Noiseless Trunkline Delays. Nonel will not initiate another Nonel Line through a "J" Hook.

PRIMER ASSEMBLIES

In all cases the LLHD Nonel Primadet of appropriate delay period is inserted into a booster. Any cap sensitive booster can be used as the Nonel tube emits virtually no side energy. The primer on the top of the explosive column would be assembled as shown in Figure 1.

Cast boosters initiated with a blasting cap provide more energy from the end opposite the cap well due to the position of the cap and slight mass difference of the cast explosive on that end. The primer on the bottom of the column would be assembled as shown in Figure 2.

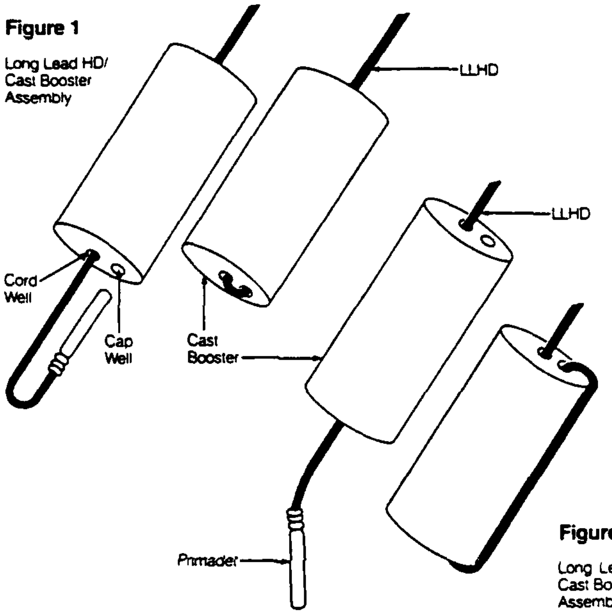


Figure 1

Long Lead HD/ Cast Booster Assembly

Figure 2 (Special Case)

Long Lead HD/ Cast Booster Assembly

With a soft package booster, the Nonel lead can be half-hitched or taped around the cartridge with the Primadet inserted fully into the base of the booster (Figure 3).

When using paper cartridge boosters, it is best to tape the Nonel lead to the booster so if the assembly needs to be pulled from the hole, it will not hang up (Figure 4).

Figure 3

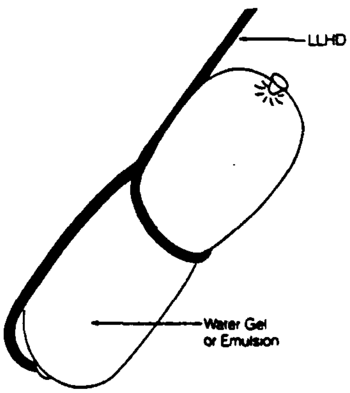
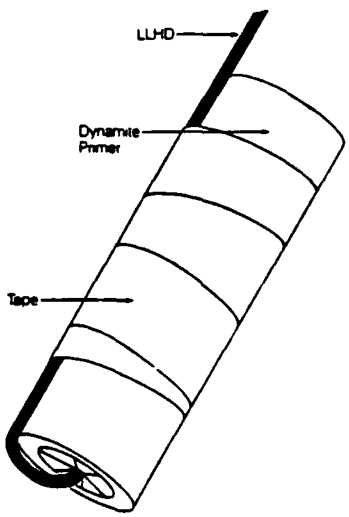


Figure 4



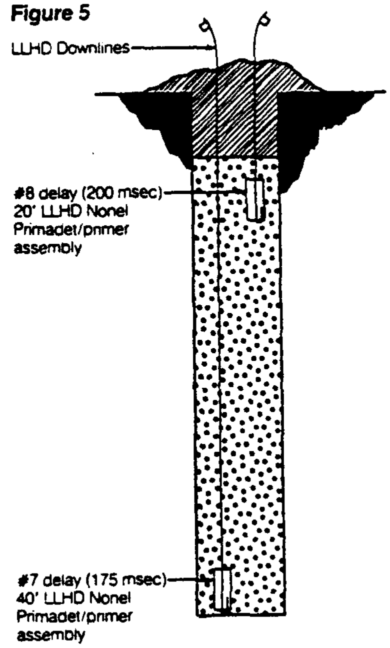
LOADING PROCEDURES

SOLID COLUMN LOADED HOLES

1. An LLHD Nonel Primadet/primer assembly is lowered into the borehole and the end of the Nonel tube is secured at the collar.
2. Explosive material is loaded into the borehole.
3. A second LLHD primer assembly is lowered to the top of the explosive column.

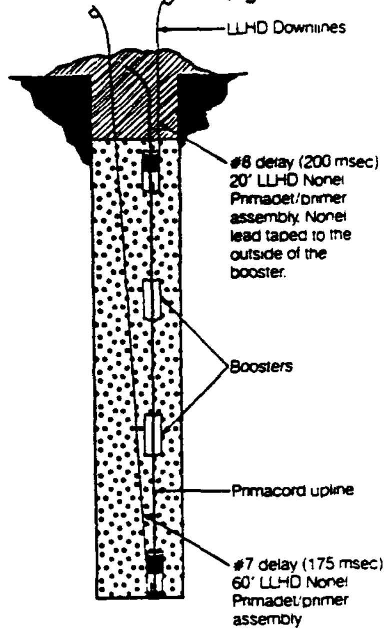
A Primacord upline may be used when loading wet bag material. Place the Nonel Primadet into the cap well of the primer; tape the Nonel tube to the outside of the primer; and run the upline through the primer as shown in Figure 6.

Figure 5



Lead lengths and delay times shown serve as examples.

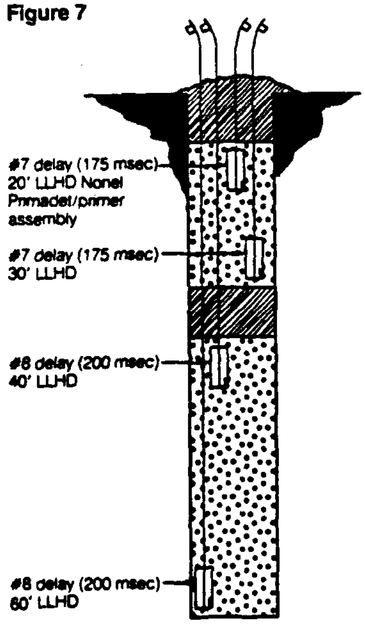
Figure 6



DECK LOADED HOLES

1. An LLHD Nonel Primadet/primer assembly is lowered into the borehole and the end of the Nonel tube is secured at the collar.
2. The explosive material is loaded into the borehole.
3. If the bottom charge is to be double primed, then a second LLHD Nonel Primadet/primer assembly of the same delay is lowered to the top of the explosive charge.
4. Stemming material for decking is loaded.
5. The above procedure is then repeated until the appropriate amount of decks are completed.

Figure 7



HOOKING UP THE SYSTEM

DELAY JUNCTION

The system in its simplest form has one or two LLHD Nonel Primadets down the hole, and one incoming and one or two outgoing NTD's (Figure 8).

The two Nonel tube ends of the outgoing NTD's and the two LLHD Nonel tube ends are placed into the Bunch Block (Figure 10). After the four outgoing Nonel tubes have been placed against the blasting cap in the Bunch Block snap the lid of the block closed (Figure 11).

When the hook-up is complete, place the assembly on the ground so the outgoing NTD tubes do not double back over or near the block. Cover the assembly with stemming material to minimize the noise from the blasting cap and to insure that the outgoing NTD tubes are not close enough to the Bunch Block to cause the tube to be damaged or cut off prior to initiation.

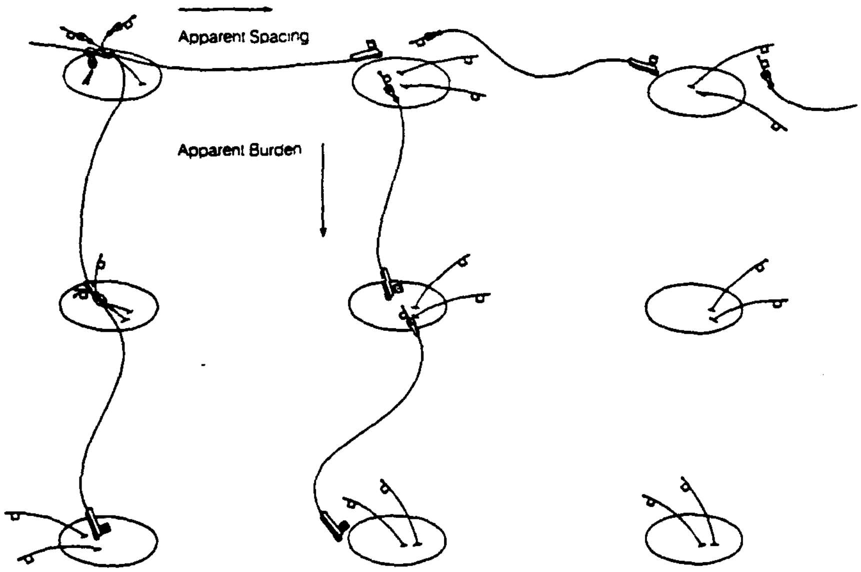


Figure 8 Blast pattern showing LLHD's and NTD's

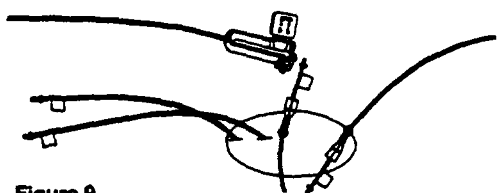


Figure 9
Note: The "J" Hook has no function in an all Nonel hook-up.

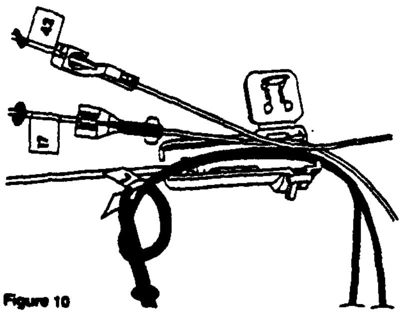


Figure 10

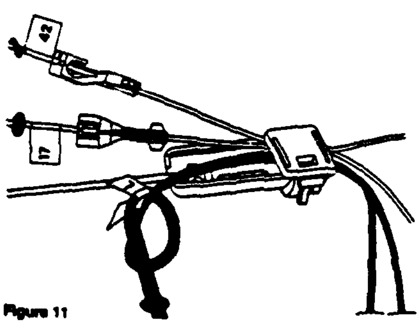


Figure 11

APPLICATIONS—DELAY PATTERNS

The Nonel System is best suited for those applications which require more delay intervals due to vibration limitations and cannot have detonating cord trunklines because of overpressure (air blast) restrictions. It is common to design blasts requiring 100 or more separate charges to be detonated with no less than 8 milliseconds between the charges. LLHD Nonel Primadets provide an unlimited number of constant, precise delay intervals when used with Nonel NTD's.

SEPARATE CHARGE FIRING—SAME DELAY EACH HOLE

A blast consisting of a single charge per hole normally has the same LLHD Nonel Primadet delay period in every hole. In some cases, the next higher delay period may be placed at the top of the column charge. Surface delay combinations of MS42 or MS25 and MS17 NTD's as shown by Figures 12 and 13 provide for two important functions:

1. The actual detonation time of the blasthole is greater than the surface activation time. Therefore, the risk of cutoff downlines or trunklines due to ground movement is minimized.
2. Blastholes detonate with a minimum of an 8 millisecond interval. An unlimited number of delays can be created with the proper selection of surface delay times and patterns.

VIBRATION CONTROL

In Figure 15 an echelon pattern is shown using 100MS NTD's across the front with 17MS on a diagonal. There are 4 decks shown per hole without duplicating inside 8 milliseconds for 3 rows. Up to 8 decks can be fired maintaining 8 millisecond minimum interval in a Three Row Pattern. To determine the surface delay across the front to accommodate a specific number of deck charges simply multiply the desired number of decks times 25MS.

For example: six separate charged decks would require 6 × 25MS or 150MS minimum across the front. Always use 17MS NTD's straight back or on the diagonal (Figure 15).

Figure 12

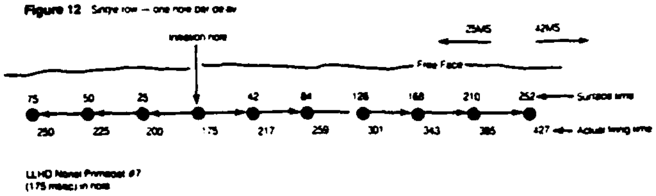


Figure 13

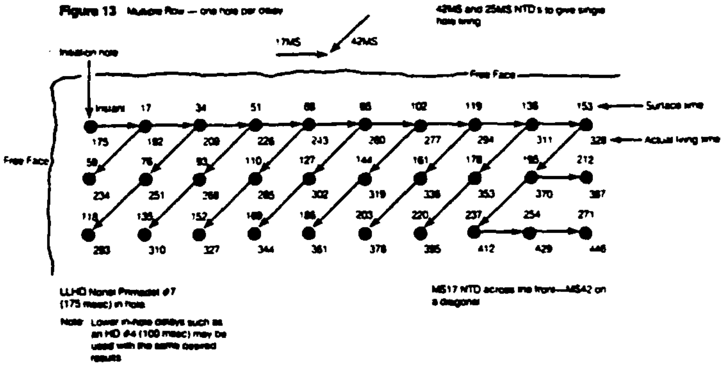


Figure 14

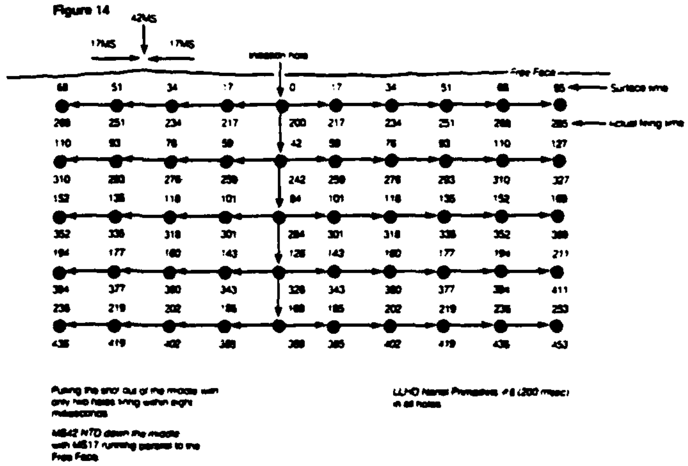
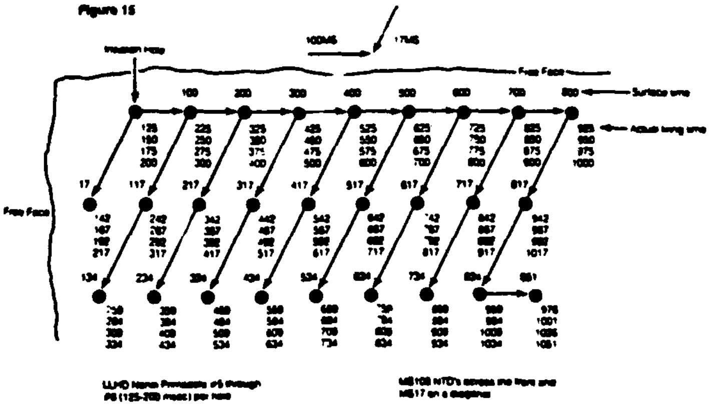


Figure 15



DELAY TIMES AND PACKAGING

LONG LEAD HD NONEL PRIMADETS

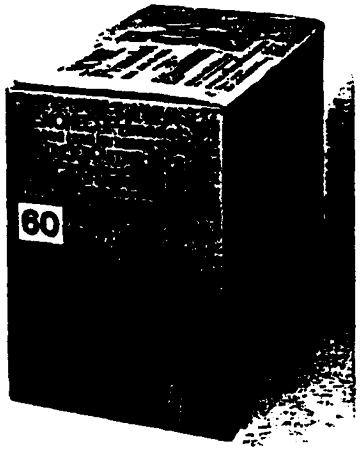
DELAY TIMES AVAILABLE

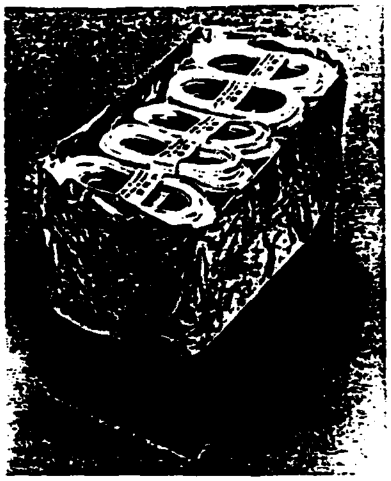
LLHD Period	Time (milliseconds)
1	25
2	50
3	75
4	100
5	125
6	150
7	175
8	200
9	250
10	300
11	350
12	400
13	450
14	500
15	600

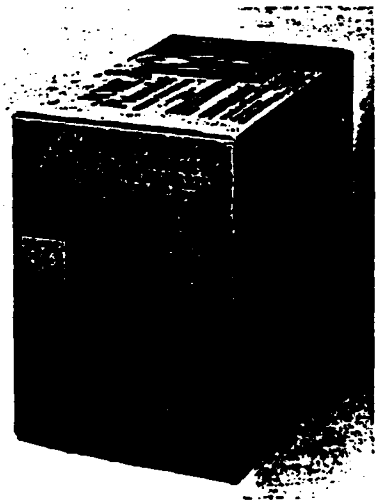
PACKAGING

Length (ft.)	Units/case	Weight/case (lbs.)
20	200	39
30	150	41
40	125	44
50	100	47
60	100	49
Case dimensions 24" × 17" × 12"		
80*	50	41
100*	50	46
120*	50	52
Case dimensions 22½" × 10" × 20"		

*Each unit comes on a 4" × 3" spool.







NOISELESS TRUNKLINE DELAYS

DELAY TIMES AVAILABLE

Time (milliseconds)	Length (ft.)	Bunch Block Color
Instant	12-20	Black
5	30-40	Black
9	50-60	Green
17	12-20-30-40-50-60	Yellow
25	12-20-30-40-50-60	Red
42	12-20-30-40-50-60	White
100	30-50-60	Black
.00	50	Black

PACKAGING

Length (ft.)	Units/case	Weight/case (lbs.)
12	300	60
20	150	29
30	150	34
40	125	34
50	100	32
60	100	34

Case dimensions 24" × 17" × 12"

IMPORTANT INSTRUCTIONS

Use only factory assembled units. Do not attempt to field-splice Nonel or knot different lengths of Nonel tube together.

Never splice Nonel tube to Nonel tube as it will not initiate itself. Do not trim ultrasonic seals from the tube since the entrance of moisture into the tube may cause misfires.

Never drive any vehicles over Nonel tube. Rupturing or damaging the tube may also cause misfires.

INITIATING THE NOISELESS TRUNKLINE SYSTEM

The primary initiating devices for the trunkline are (1) Nonel Noiseless Lead-in Lines, (2) electric blasting caps, and (3) cap and safety fuse assemblies. Never attach a blasting cap for the purpose of initiating a blast until everything and everybody are in a safe area.

Make the primary initiating device attachment the very last step in readying the blast. Attachment of the primary initiating device should be made to the first hole to fire in the blast. This hole fires which in turn fires outgoing noiseless trunklines.

DISCLAIMERS

ATTENTION

The information and recommendations described in this bulletin cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations herein are based on the manufacturer's experiences, research, and testing. They are believed to be accurate, but no warranties are made, expressed or implied. Also, the specifications contained herein are all nominals which represent our current production. The product described may be subject to change. Please feel free to contact the Ensign-Bickford Company for verifications.

NO WARRANTIES OR LIABILITIES

The product described herein is sold "as is" and without any warranty or guarantee, express or implied, arising by law or otherwise, including without limitation any warranty of merchantability or fitness for any purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller's negligence or based upon strict products liability or upon principles of indemnity or contribution.

Nonel Primadets are manufactured under U.S. Patent #3,590,739, U.S. Patent #3,125,024 and other patents pending.

The Ensign-Bickford company

Simsbury, Connecticut 06070

Ensign-Bickford Sales Offices:

660 Hopmeadow Street
Simsbury, CT 06070
203/658-4411

Post Office Box 97
Louviers, CO 80131
303/798-8625

5011 Washington Avenue
Evansville, IN 47715
812/476-1329

Post Office Box 322
Wexford, PA 15090
412/935-5712

5036 Snapfinger Woods Drive
Decatur, GA 30035
404/987-1000

3000 - 8/84 #107-A

PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

December 1, 1989

Serial Letter No.: 052/02219/7

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Blasting and Explosive Materials

Gentlemen:

Reference is made to Technical Provision 02219/7, and specifically your serial letter number 13, in which the Contracting Officer addressed his concerns regarding the transportation, storage, and use of explosive products on the project site. Enclosed please find four (4) copies of PCL Civil Constructors General Blast Plan which was prepared by our subcontractor, McCaw Drilling (USA) Inc. The General Blast Plan includes the resumes of the blasting supervisors, locations, dimensions, applicable distances, and security features of the storage magazines, as well as other pertinent aspects of the blasting operations. The Job Hazard Analysis for blasting and rock excavation has been previously submitted under PCL Civil Constructors serial letter number 047/01420/EM385/Appendix Y.

I trust the enclosed information will adequately address the Contracting Officer's concerns and subsequently grant written permission to allow explosive products to be transported onto the project site.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

P.O. Box 2270, Truth or Consequences, N.M. Telephone 505-743-7834 Rapidfax 505-743-7836
"AN EQUAL OPPORTUNITY EMPLOYER"

McCAW'S DRILLING (USA), INC.
CUCHILLO DAM PROJECT

BLASTING PROPOSAL

NOVEMBER, 1989

TABLE OF CONTENTS

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GENERAL PROCEDURES.	1
INITIATION SYSTEM.	2
PRE-SPLIT.	3
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RESUMES AND QUALIFICATIONS OF BLASTERS	APPENDIX A
TECHNICAL SPECIFICATION SHEETS	APPENDIX B
MAGAZINE LOCATION AND SPECIFICATIONS	APPENDIX C
COPY OF BLASTING REPORT.	APPENDIIX D

1. GENERAL PROCEDURE

1. All blasting will be done by experienced and competent personnel employed by McCaw's Drilling (USA), Inc. Technical assistance will be supplied by:

   a. W.H. Burt Explosives, Inc.
      P.O. Box 850
      Moab, UT 84532

   b. Ireco, Incorporated
      Grand Junction, Colorado

2. Resumes and qualifications of the individuals who will be responsible for the blasting operations are presented in Appendix A. High explosives, blasting agents, detonators and accessories will be supplied by W.H. Burt Explosives, Inc. Moab, Utah. Technical Specifications sheets for the explosives products that we anticipate utilizing on this project are attached (Appendix B).

3. The explosives will be stored at a magazine location near the jobsite that will be selected to comply with all Local, State and Federal laws as well as the United States Army Corps of Engineers Manual EM 385.1.1, Section 25.A.19. Magazines for storing explosives will be provided by W.H. Burt Explosives, Inc. The magazines have been federally inspected and meet the standards of the Bureau of Alcohol, Tobacco and Firearms as outlined in 27 CFR 55, Subpart K. The explosives will be transported from the magazines to the blast site in a vehicle that meets the standards and specifications required by Local, State and Federal and United States Army Corps of Engineers Rules and Regulations. The magazine locations and dimensions are presented in Appendix C.

4. The explosives products that we anticipate using on this project are as follows:

   a. <u>Ireco High Explosives</u>
      (i) Unigel 2" X 8"
      (ii) Unimax 2" X 16"
      (iii) Iresplit D 7/8" X 24"

   b. <u>Engisn Bickford Products</u>
      (i) MS Nonel Primadets
      (ii) MS Surface Connectors
      (iii) E-Cord (35 grains per foot)

   c. <u>Blasting Agents</u>

      (i) Burtmix #1 (Ammonium Nitrate/Fuel Oil Mixture)

5. Our firm will be submitting detailed blasting reports for each blast per Section 7.2.1.5 and Section 7.6 of the Contract Documents. A copy of the proposed shot report form is presented in Appendix D.

2. INITIATION SYSTEM

1. McCaw's Drilling (USA), Inc. will employ a totally non-electric initiation system on this project. By using the Nonel system we will eliminate safety concerns and problems commonly caused by extraneous electric current when using other than the Nonel system. Nonel tube cannot be initiated by high frequency radio transmissions, static or stray electrical energy, flame, friction, or impact commonly found in a construction environment.

2. Technical Description

Appearance ....Plastic Tube
Dimensions.........................0.12 inches O.D.
.........................X 0.05 inchs I.D.
Powder Weight......................0.1 grains per foot
Detonation Velocity................6000 feet per second

The Nonel plastic tube contains only one pound of explosives material per 70,000 feet of tube.

3. **PRE-SPLIT**

1. Presplit holes will be 2 1/2" in diameter. The spacing of the drill holes shall be that which yields the most satisfactory results as determined by test blasting to be conducted on-site but in any case shall not exceed 30 inches. Alignment of the drill stem to the specified angle of pitch shall be accomplished by the use of a "degree rule" and/or plywood templates. The column load for presplit holes shall be Iresplit D (Appendix B). The actual firing of the pre-split holes shall be by one of the following methods as determined by the site conditions:

   a. The pre-split holes are fired prior to drilling the production and buffer holes.

   b. The pre-split holes are fired concurrent with but prior to the production and buffer holes on a millisecond delay system as per Section 7.2.1.3 of the contract documents.

   c. Cushion Blasting - where the pre-split are fired with the general blast holes but delayed to detonate <u>after</u> the general blast holes per Section 7.3 of the Contract Documents.

4. PRODUCTION

It is not possible nor practical at this stage to firmly state the patterns, delayment and powder factors that are to be used for each blast on this project because of the many variables that go into a blast design. It is our intention to proceed with test drilling as per Section 7.2.1.5 and 7.2.1.7 of the Contract documents. Our firm will submit a detailed proposal for the test blasts after examination of the test blast area and prior to the start of drilling.

Generally, our blast design will adhere to the following guidelines and Section 7 of the Contract documents:

(a) Bore hole diameter will be three inches.

(b) Burden shall not exceed spacing.

(c) Spacing shall not exceed depth of the bore hole.

(d) Collar shall be adjusted to suit the field conditions.

(e) The powder factor shall be that which yields the best results based on fragmentation, control of fly rock and impact on the finished lines and grades.

We will use bottom detonation of the bore hole which will be achieved by inserting a primer with a Nonel detonator at the bottom of the bore hole prior to loading the column load. Surface tie-in will be detonating cord and MS connectors. A typical column load is shown on the sketch in Appendix B.

5. SAFETY

Safety has always been a top priority with our firm and we are proud of our excellent safety record.

On this project we will be following the safety program established by the General Contractor including testing for substance abuse.

In addition to this we will have an orientation session with each employee at the time of hiring specifically tailored to working with explosives.

The receiving, transporting, handling and use of explosives will be in accordance with all applicable Local, State and Federal laws and the United States Army Corps of Engineers Manual EM 385-1-1, Section 25.A.19.

We request that only those persons directly involved with the blasting be allowed in the blasting area during the loading and tie-in of the blast. Prior to blasting a series of signals will be sounded on an air horn attached to a 800 CFM, 120 PSI Compressor as per Section 25.J.03 of the United States Army Corps of Engineers Manual Em385-1-1. The signals to be used will be posted at various locations around the jobsite.

APPENDIX A

RESUME

GERALD R. MCCAW

PERSONAL DATA:

Address: 3707 - 55 Street
Rocky Mountain House, AB TOM 1TO

Telephone: 845-5347 (Residence)

Marital Status: Married

Birthdate: Born in Nipawin, Saskatchewan
August 8, 1958

EXPERIENCE:

1979 - 1980 Dywidag Canada Ltd.

* Job Supervision
* Drilling Procedures
* Grouting Procedures

1982 to Present: Partner in McCaw's Drilling & Blasting Ltd. Held positions of driller, blaster, project superintendent and Northern Operations Manager.

MAJOR PROJECTS:

* Fish Creek Sewage Treatment Plant 1982
  Calgary, Alberta

  Drilling, installation and testing of 560 anchors.

* Deerfoot Trail and Southland Drive Overpass 1981/1982
  Calgary, Alberta

  Installation, testing and grouting

* Nipawin, Hydroelectric Project (1984)
  Nipawin, Saskatchewan

  Drilled and prepared holes for anchor installatiuon done by Dywidag, while assisting in installation for spillway.

* CPR Project, Cana Construction (1984)
  Rogers Pass, B.C.

  Drilled and installed 130 anchors for Ventilation Shaft.

... /2

<u>MAJOR PROJECTS:</u>
(continued)

* Goodbrand Construction (1985)
  Rogers Pass, B.C.

  Drilled and installed 900 soil anchors for retaining walls.

* Syncrude Canada (1984 - 1986)

  Superintendent on a controlled drill/blast project in Tar Sands. Seven drills and compressors on site. Approximated contract volume $ 700,000.

* Yellowknife, N.W.T. (1988 - 1989)

  Operations Manager on numerous controlled blasting projects including:

  * three major quarry projects;
  * two major road building projects;
  * four major sub-division projects;
  * numerous excavation projects.

  Approximate volume of rock work looked after during this period $ 4,500,000.

* From 1982 to 1985 worked as a blaster on a number of major pipeline projects throughout Alberta.

<u>QUALIFICATIONS:</u> Holds valid blasting tickets in Alberta, Northwest Territories as well as a Quarry Foreman's Ticket for Alberta.

Alberta
WORKERS' HEALTH, SAFETY
AND COMPENSATION
Occupational Health & Safety Division

Blaster's Certificate

This is to Certify that JOE McCAW

of ROCKY MOUNTAIN HOUSE, ALBERTA, upon

examination and the recommendation of the District Mine Inspector is hereby granted this certificate

under The Quarries Regulation Act.

Dated at Edmonton, Alberta this 22nd day of March 19 84

No. B-007-

DIRECTOR OF MINES INSPECTION

Mrch 10, 89

Northwest Territories

MINING INSPECTION SERVICES

No. 89-44

EXPLOSIVES PERMIT

FORM B

I hereby certify that Joe G. McCAR

of P.O. Box 2250, Rocky Mountain House, Alberta

is authorized to handle and use explosives in the Northwest Territories. (Subject to such measures or limitations as are shown.)

Joe McCar
Permittee

Bert Dobby
Inspector or Deputy Inspector

Limitations

1. Permit expires June 10 19 89

2. Other conditions

"SURFACE BLASTING ONLY"
NO TAPE FUSES ALLOWED IN THE NORTHWEST TERRITORIES

NWT 2281 80/0981

RESUME

KEVIN JOE

DATE OF BIRTH: August 22, 1948

WORK HISTORY:

McCaw's Drilling (USA), Inc. October 1986 - Present
Denver, Colorado

Responsible for blast design, receiving, transporting, loading and firing of explosives on various construction projects across Canada. Scope of projects ranged from demolition projects in the High Arctic (Baffin Island), highway projects in British Columbia, Alberta and Ontario and several pipeline projects. Types of blasting varied from controlled blasting as close as ten feet to sour gas lines under very high pressures to large quarry blasts.

Canadian Pacific Railways 1984 - 1985
Calgary, Alberta

Inspector on the Roger's Pass tunnel project in British Columbia. Monitored contractors progress and adherence to contract specifications with particular emphasis on the drill and blast operations.

Loram International Ltd. 1983 - 1984
Calgary, Alberta

Employed as foreman on two site grading projects in the Dallas-Forth Worth Area.

Northern Construction Ltd. 1983
Vancouver, British Columbia

Employed as foreman at the Ridley Island Grain Terminal Project in Prince Rupert, British Columbia. Supervised excavation crews, including drillers and blasters during the site grading phase of the project.

Loram International Ltd. 1968 - 1979
Calgary, Alberta

Worked on various large projects in Canada (up to $100 million) in variuos capacities - surveyor, field engineer, foreman and superintendent. Involved in all phases of blasting from estimating to blast design, load and shoot.

... /2

CERTIFICATES HELD:

1. Alberta Blasting Permit Number 20163.
2. Northwest Territories Blasting Permit #89-004.
3. Diploma - Applied Explosives Technology and Safety.
4. Certificate of Training "Transportation of Dangerous Goods".

RESUME

KEVIN JOE

DATE OF BIRTH: August 22, 1948

WORK HISTORY:

McCaw's Drilling (USA), Inc. October 1986 - Present
Denver, Colorado

Responsible for blast design, receiving, transporting, loading and firing of explosives on various construction projects across Canada. Scope of projects ranged from demolition projects in the High Arctic (Baffin Island), highway projects in British Columbia, Alberta and Ontario and several pipeline projects. Types of blasting varied from controlled blasting as close as ten feet to sour gas lines under very high pressures to large quarry blasts.

Canadian Pacific Railways 1984 - 1985
Calgary, Alberta

Inspector on the Roger's Pass tunnel project in British Columbia. Monitored contractors progress and adherence to contract specifications with particular emphasis on the drill and blast operations.

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Calgary, Alberta

Worked on various large projects in Canada (up to $100 million) in various capacities - surveyor, field engineer, foreman and superintendent. Involved in all phases of blasting from estimating to blast design, load and shoot.

... /2

CERTIFICATES HELD:

1. Alberta Blasting Permit Number 30163.
2. Northwest Territories Blasting Permit #89-004.
3. Diploma - Applied Explosives Technology and Safety.
4. Certificate of Training "Transportation of Dangerous Goods".

This permit expires on
MARCH 25 19 93
unless previously cancelled
or suspended.

No. 20163

Alberta

Community and
Occupational Health

Occupational Health
and Safety Division

PERMIT

TO USE, HANDLE, PREPARE AND FIRE EXPLOSIVES

Issued to MCCAW'S DRILLING & BLASTING
EMPLOYER

of ROCKY MOUNTAIN HOUSE, ALBERTA

This permit authorizes KEVIN JOE

to use, handle, prepare and fire explosives for the employer named herein while

engaged in DRILLING & BLASTING - HEAVY CONSTRUCTION operations.

Dated this 25 Day of MARCH 19 88

This permit shall be retained in the possession of the employer and must be returned to the Occupational Health and Safety Division, Community and Occupational Health immediately the worker terminates employment with the employer named herein.

For EXECUTIVE DIRECTOR
WORK SITE SERVICES

June 26 19 89

Northwest Territories

MINING INSPECTION SERVICES

89-004

EXPLOSIVES PERMIT

FORM 8

I hereby certify that Kevin JOE

of 828 Lysander Drive S.E., Calgary, Alberta

is authorized to handle and use explosives in the Northwest Territories. (Subject to such structures or limitations as are shown.)

Permittee

~~Inspector~~ or Deputy Inspector

Limitations

1. Permit expires N/A 19____

2. Other conditions "SURFACE BLASTING ONLY"
NO TAPE FUSES ALLOWED IN THE NORTHWEST TERRITORIES

NWT2281-80/0981

DU PONT CANADA INC.
APPLIED EXPLOSIVES TECHNOLOGY SEMINAR

This is to certify that

K. Joe

has completed a short course on

APPLIED EXPLOSIVE TECHNOLOGY & SAFETY

Dated this 25 day of February, 1981

EXPLOSIVES
DU PONT
CANADA

ACE EXPLOSIVES TECHNICAL AND PLANNING MANAGER

TECHNICAL SERVICE SUPERVISOR

WESTERN DISTRICT SALES MANAGER

Certificate of Training

This is to certify that

KEVIN JOE

NAME

is a trained person pursuant to Section 9.3 (a)(b) of the TRANSPORTATION OF DANGEROUS GOODS REGULATIONS and is authorized to serve as, or in the capacity of

FIELD ENGINEER

(DUTIES, TITLE OR AUTHORIZED ACTIVITY)

Certified by

Date OCT 15-86

for McCaw

EMPLOYER

McCAWS DRILL & BLAST

COMPANY

APPENDIX B

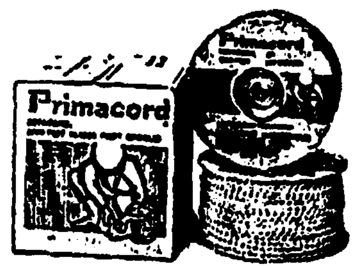
DETACORD®

Core Load	Tensile Strength	Outside Diameter	Color and Identification	Intended Use
18 gr/ft 3.6 gm/m	150 lbs 68 kg	0.142 in 3.607 mm	Yellow with one black countering yarn	Downline, Trunkline

Application

Detacord will detonate through standard knot connections and will initiate other detonating cords. It will initiate nitroglycerin-based explosives and most other cap-sensitive products. It is of less rugged construction than most other Primacord products so it should be used in less rigorous applications. Detacord is flexible, easy to handle, and readily ties and holds knots.

It should be noted that Detacord may not be a reliable initiator of most cast boosters. The manufacturer of the boosters should be consulted before using Detacord in this manner.



Special Packaging

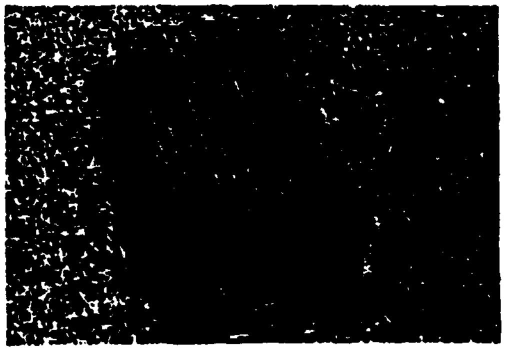
Detacord is available in either of two types of packages: two-1000 foot (305 m) spools per shipping container, or a 1,000 foot (305 m) spool in a "pull-out"-type box. The pull-out box is a heavy solid fiber carton with a 4-inch (10 cm) diameter "knock-out" section which, when removed, exposes the free end of the Detacord. The cord can then be withdrawn from the box by simply pulling on the free end.

Packaging	Package Size	Shipping Weight
2-1000 ft spools 2-305 m spools	9.75 × 9.75 × 10.5 (in) 24.8 × 24.8 × 26.7 (cm)	17.0 lbs 7.7 kg
1-1000 ft spool (pull-out)	10.75 × 4.88 × 11 (in)	8.5 lbs
1-305 m spool (pull-out)	27.3 × 12.4 × 28 (cm)	3.8 kg

IRECO Incorporated Technical Information Ireco
Eleventh Floor Crossroads Tower Salt Lake City, Utah USA 84144 Telephone: (801) 364-4800 Telex: 38-6353

IRESPLIT™ D
Dynamites for Perimeter Control

IRESPLIT D products are explosives designed for open pit or underground blasting operations where precision overbreak control is desired. When used with presplitting or perimeter (smoothwall) blasting techniques, IRESPLIT D produces straight-lined, smooth-faced walls in reasonably homogeneous rock formations.



IRESPLIT D cartridges in case - note the sleeve glued onto each cartridge

Advantages

Product Variety. IRECO offers IRESPLIT D, a semigelatin dynamite, and IRESPLIT D-1, a low-density, high ammonium nitrate dynamite. Both are packaged in 24-inch cartridges of various diameters.

Minimized Rock Overbreak. Rock overbreak behind the IRESPLIT blastholes is minimized. This results in less unpaid-for excavation and extra concrete being required.

Easy Assembly. IRESPLIT cartridges have connecting sleeves securely glued onto one end of each cartridge.

Properties

Explosive Type	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
IRESPLIT D [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
IRESPLIT D-1 [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Iresplit PG2

IRECO Incorporated

Packaging

Diameter x Length (inches)	IRESPLIT D Count	[illegible]	IRESPLIT D-1 Count	lb/c
7/8 x 24	[illegible]80*	[illegible]	70-82*	[illegible]
1 x 24	[illegible]65*	[illegible]	54-62	[illegible]
1-1/8 x 24	[illegible]	[illegible]	70-74	[illegible]
1-1/4 x 24	43-47	[illegible]	[illegible]	[illegible]

* Packed to count
** 40 lb. case. All others are 50 lb.

Priming and Loading

The paper sleeve connector enables coupling of each IRESPLIT D or D-1 cartridge into a continuous explosive column. For loading into vertical holes the column is lowered into the borehole by a detonating cord downline. The detonating cord is commonly half-hitched or taped tightly around the first cartridge in the borehole. At approximately six-foot intervals, the detonating cord should be secured to the column of explosive so it remains in close contact to ensure propagation of the entire column. IRESPLIT D has good water resistance. IRESPLIT D-1 should not be exposed to other than minor amounts of borehole water.

For horizontal holes the cartridges are connected by the sleeves and primed with a separate cartridge of larger-diameter dynamite. Cord is not ordinarily used in horizontal applications unless the column consists of more than 3 IRESPLIT cartridges.

Transportation, Storage and Handling

Stock should be rotated. Avoid using new materials before the old. For recommended good practices in transporting, storing, handling, and using this product, see the Booklet "Prevention of Accidents in the Use of Explosive Materials" packed inside each case, and the Safety Library publications of the Institute of Makers of Explosives.

The IRESPLIT D and D1 are classified as High Explosives and must be transported, stored, handled, and used in conformity with all applicable Federal, state, and local laws and regulations.

Product Disclaimer

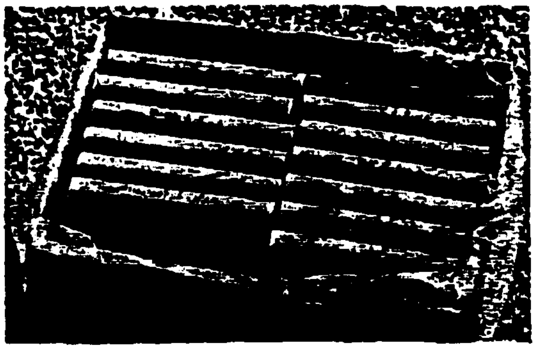
IRECO disclaims any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall IRECO be liable for special, consequential or incidental damages or for anticipated profits.

Uniqel PG1

IRECO Incorporated Technical Information ireco
Eleventh Floor Crossroads Tower Salt Lake City, Utah USA 84144 Telephone: (801) 364-4800 Telex: 38-8353

UNIGEL®
Semigelatin Dynamite

UNIGEL was specifically developed for all-purpose blasting applications, including underground and surface mining. It replaces more expensive specialty-grade dynamites that offer varying energy values with each grade. UNIGEL has excellent uniformity of mixture and plasticity, will perform satisfactorily under moderate water pressure, and is an excellent primer for ANFO.



Advantages

Universal Blasting Applications. UNIGEL is a single explosive grade for universal blasting applications, which simplifies inventory requirements.

Fumes. Afterblast fumes and smoke are at a minimum.

Cost-Saving. UNIGEL provides excellent performance for less cost per cubic yard.

Properties

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

ANFO [illegible]

Characteristics

Water Resistance	**Good**
Fume Class	**IME 1**
Sensitivity Restriction	**As with all dynamites, will side-initiate when in contact with detonating cord of any coreload.**

The Explosives Technology Company

8-03C-01-89 2K

UNIGEL P. 15

IRECO Incorporated

Packaging

This table shows some of the cartridge sizes available:

Diameter x Length (Inches)	Nominal Cartridge Count per 50 lb. Case
1-1/8 x 8	134-142
1-1/4 x 8	109-115
1-1/2 x 8	76-82
2 x 8	41-45
2 x 16	20-22
2-1/2 x 16	13-14
3 x 16	10

Notes:

1. The above is for count information only. Some sizes are non-standard (i.e. produced only to special order), and may involve a surcharge.
2. Other sizes are available, including king-size (to 24" length), large diameter tube shells, and DOT-23G shells having a minimum diameter of 4".

Transportation, Storage and Handling

UNIGEL has a D.O.T. classification as a High Explosive Class A and must be transported, stored and handled in conformity with applicable federal, state and local laws.

Refer to IME Safety Library Publications for information on proper explosives usage.

Product Disclaimer

IRECO Incorporated Technical Information IRECO
Eleventh Floor Crossroads Tower Salt Lake City, Utah USA 84144 Telephone: (801) 364-4800 Telex: 38-8353

Extra gelatin
PG1

EXTRA GELATIN
Gelatin Explosives

EXTRA GELATIN explosives differ from regular gelatin explosives in that part of the sensitizer is replaced during manufacture by ammonium nitrate. Grade for grade, Extra Gelatin is more economical yet equivalent in weight strength, and only slightly less water resistant than straight gelatin explosives. Its gelatin consistency makes tamping easy, and it is sufficiently cohesive for use in loading drill holes with an upward slant. IRECO Extra Gelatin is available in marked strengths of 40%, 60% and 75%.

Advantages

Economy. Extra Gelatins maintain many of the superior qualities of a straight gelatin, at a lower cost.

Fume Class 1. All strengths meet IME Fume Class 1, *making them suitable for most underground* mining conditions.

High Detonation Rate. IRECO Extra Gelatins provide excellent results in those applications where a high detonation velocity is called for.

Excellent Water Resistance.

Properties

	Density	Energy cal/gm	Weight Strength	Bulk Strength	[illegible]	[illegible]
Extra Gelatin 40%	1.53	955 [illegible]	1.09	[illegible]	[illegible]	[illegible]
Extra Gelatin 60%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Extra Gelatin 75%	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

[illegible]

D-15A-09-88-2K

IRECO Incorporated

ireco

Extra Gelatin pg 2

Packaging

Cartridge count range per 50 lb. case:

Cartridge Size (inches)	Extra Gelatin 40%	60%	75%
7/8 x 8	175-189	185-199	189-203
1 x 8	131-143	141-153	146-158
1 1/8 x 8	111-121	120-130	123-133
1 1/4 x 8	91-98	98-105	101-108
1 1/2 x 8	63-69	68-74	69-75
1 3/4 x 8	44-50	48-54	50-56
2 x 8	34-38	37-41	38-42
2 x 16	17-20	19-21	19-21
2 1/2 x 16	11-12	12-13	12-13
3 x 16	8	9	9

NOTES:

1. The above is for count information only. Some sizes are non-standard (i.e. produced only to special order), and may involve a surcharge.
2. *Other sizes are available, including king-size (to 24" length)*, and DOT-23G shells having a minimum diameter of 4".

Transportation, Storage and Handling

Extra gelatin explosives are classified as high explosives, Class A, and must be transported, stored, handled, and used in conformity with applicable Federal, state and local laws and regulations.

Refer to IME Safety Library Publications for information on proper explosives usage.

Product Disclaimer

IRECO disclaims any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied, INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall IRECO be liable for special, consequential or incidental damages or for anticipated profits.

Eleventh Floor Crossroads Tower Salt Lake City, Utah USA 84144 Telephone (801) 364-4800 Telex 38-8353

UNIMAX™
Extra Gelatin Dynamite

UNIMAX is a nitroglycerin-sensitized extra gelatin designed as a primer for insensitive blasting agents or for use alone in extremely wet conditions where a high density product with high energy may be required. UNIMAX has been formulated to give consistently high detonation velocity. It is a less expensive product than the regular gelatins, but has only slightly less water resistance.

Advantages

Universal Blasting Applications. UNIMAX is an excellent choice for use in difficult water conditions, including moderate pressures and potential dead-pressing situations. It also is an excellent primer for ANFO or other blasting agents.

Fumes. Afterblast fumes and smoke are at a minimum.

Cost-Saving. UNIMAX provides excellent performance for less cost per cubic yard of broken rock than the NG gelatin explosives.

Properties

Density (g/cc)	Energy (cal/gm) (cal/cc)	Weight Strength*	Bulk Strength*	Velocity (m/sec) (ft/sec)	Velocity (m/sec) (ft/sec)	Detonation Pressure (K bars)
1.43	1,050 1,500	1.19	2.08	5,300 17,400	6,000 19,700	[illegible]

*ANFO = 1.00 at density 0.82 g/cc   1 1/4 inch diameter, unconfined   2 inch diameter, unconfined

Characteristics

Fume Class	IME 1
Water Resistance	Excellent

D-01A-05-88-2K

Packaging

UNIMAX is packaged in orange paper shells.

Cartridge Size (inches)	Nominal Cartridge Count per 50 lb. Case
7/8 x 8	185-199
1 x 8	141-153
1-1/8 x 8	120-130
1-1/4 x 8	98-105
1-1/2 x 8	68-74
1-3/4 x 8	48-54
2 x 8	37-41
2 x 16	19-21
2-1/2 x 16	12-13
3 x 16	9

NOTES:

1. The above is for count information only. Some sizes are non-standard (i.e. produced only to special order), and may involve a surcharge.
2. Other sizes are available, including king-size (to 24" length), large diamater tube shells, and DOT-23G shell having a minimum diameter of 4".

Transportation, Storage and Handling

UNIMAX has a D.O.T. classifications as a High Explosive Class A and must be transported, stored and handled in conformity with applicable federal, state and local laws.

Refer to IME Safety Library Publications for information on proper explosives usage.

Product Disclaimer

IRECO disclaims any warranties with respect to this product, the safety or suitability thereof, or the results to be obtained, whether express or implied. INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND/OR ANY OTHER WARRANTY. Buyers and users assume all risk, responsibility and liability whatsoever from any and all injuries (including death), losses, or damages to persons or property arising from the use of this product. Under no circumstances shall IRECO be liable for special, consequential or incidental damages or for anticipated profits.

BURT EXPLOSIVES

Technical Information

BURT MIX® 1 Blasting Agent

BURT MIX® 1 is a premixed, prilled ammonium nitrate/fuel oil-type, 65% weight-strength blasting agent[1] suitable for use under dry borehole conditions. It can be used for quarry, open-pit and construction, or underground blasting operations, and can be either blown into the borehole by pneumatic loading devices or poured.

This highly economical blasting agent has an average poured density of about 0.80 g/cm³, or 50 lbs/ft³. When holes are loaded pneumatically, average density is about 0.95 g/cm³, or 60 lbs/ft³.

BURT mix 1 blasting agent, as packed and when used under dry borehole conditions, will produce Class 1 fumes.

[1] Blasting agent: Any material or mixture consisting of a fuel and oxidizer, intended for blasting, not otherwise classified as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined.

Typical Characteristics

Measured energy, ft-lbs/lb × 10⁶ 1.10

Measured energy, ft-lbs/ft³ 54

APPROXIMATE LOADING DENSITY AND RATE OF DETONATION

Borehole Diameter, in.	mm	Approximate Weight per Foot of Borehole When Poured, lbs	kg	Approximate Detonation Velocity (confined), fps	mps
2	51	1.1	0.50	10,700	3,261
3	76	2.4	1.09	10,900	3,322
4	102	4.4	2.00	11,800	3,597
5	127	6.8	3.08	12,400	3,780
6	152	9.8	4.44	12,800	3,901
7	179	13.3	6.02	13,100	3,993
8	203	17.4	7.88	13,300	4,054
9	229	22.0	9.97	13,400	4,084
10	254	27.2	12.32	13,500	4,115
11	279	32.9	14.90	13,600	4,145
12	305	39.2	17.76	13,650	4,160
13	330	46.0	20.80	13,700	4,176
14	356	53.3	24.14	13,700	4,176
15	381	61.2	27.72	13,750	4,191
16	406	69.6	31.53	13,750	4,191
17	432	78.6	35.61	13,750	4,191
18	457	88.1	39.91	13,750	4,191

(over)

We cannot anticipate all conditions under which this information and our products, or the products of other manufacturers in combination with our products, may be used. We accept no responsibility for results obtained by the application of this information or the safety and suitability of our products, either alone or in combination with other products. Users are advised to make their own tests to determine the safety and suitability of each such product or product combination for their own purposes. Unless otherwise agreed in writing, we sell the products without warranty, and buyers and users assume all responsibility and liability for loss or damage arising from the handling and use of our products, whether used alone or in combination with other products.

Packaging

BURT mix I blasting agent is furnished in 50-lb (22.7-kg) net polyethylene-lined, multiwall paper bags.

Transportation, Storage, and Handling

This blasting agent is not initiation-sensitive to No. 8 blasting caps or rifle bullets, and thus need not be stored in bullet-resistant magazines unless so required by relevant laws or regulations. Storage magazines should be located to conform to the American Table of Distances and the Table of Separation Distances of Ammonium Nitrate and Blasting Agents From Explosives or Blasting Agents.

BURT mix is classified by the U.S. Department of Transportation as Blasting Agent, and must be transported, stored, handled, and used in conformity with all applicable Federal, state, and local laws and regulations. The proper shipping description and hazard classification for BURT mix I as described in this bulletin is:

Ammonium Nitrate/Fuel Oil Mixture—Blasting Agent

This product should be kept dry, and stock should be rotated so that the oldest material is used first. Use only proper primers, and never load in wet holes or where there is not adequate confinement. If these restrictions are observed, the formation of toxic fumes will be minimized. This product, as manufactured, conforms to the Institute of Makers of Explosives Fume Class I rating.

For additional recommended good practices in transporting, storing, handling, and using this product, consult the Safety Library Publications of the Institute of Makers of Explosives.

TECHNICAL BULLETIN

MS nonel pal

The
Ensign-Bickford
company

NONEL®
Primadet®

Nonelectric delay detonators

MS SERIES

Precise nonelectric delay blasthole initiation for all surface mining, quarries and construction needs.

DESCRIPTION

Nonel® Primadet® nonelectric delay detonators are comprised of four major components.

A Nonel® shock tube to transmit a signal to the delay cap. Nonel® shock tube is a small diameter plastic laminate tube coated with a very thin layer of reactive material; only one pound of material per 70,000 feet of tube. When initiated, Nonel® shock tube reliably transmits a low energy signal at approximately 6,500 feet per second from one point to another. This shock wave phenomenon, which is similar to a dust explosion, will propagate through most sharp bends, knots and kinks in the tube. The detonation is sustained by such a small quantity of reactive material, the outer surface of the tube remains intact during and after functioning.

A blasting cap with integral delay element.

A color-coded delay tag which indicates the MS delay period number and nominal firing time.

A "J" Hook to facilitate easy connection to a Primacord® detonating cord trunkline. These white plastic hooks are inert.

ADVANTAGES

Simple-Flexible Nonel® Primadet® components are factory assembled, no field cutting and assembly of initiation components is required. They can be readily and simply connected to accommodate both basic and complex blast initiation requireme-

Reliable Nonel® Primadet® none... tric delay detonators are factory assembled under stringent quality specifications to insure reliable performance in the field blast after blast.

Nonelectric Nonel® shock tube cannot be initiated by high frequency radio transmissions, static or stray electrical energy, flame, friction or impact found in normal mining conditions. However, blasting caps are far more sensitive to these conditions. Requires no knowledge of electric circuitry. No need to instruct blasters on intricacies of electric circuits. No need for elaborate training and retraining of blasters.

Noiseless The Nonel® Primadet® initiation system is quiet. The signal moving through an initiated tube is so quiet that it can be called Noiseless.

Economical The Nonel® Primadet® system allows for a reduced inventory resulting from the elimination of stocking various lengths of a complete delay series.

MS Nonel pg 2

IMPORTANT INSTRUCTIONS

Use only factory assembled units. Do not knot different lengths of Nonel® shock tube together.

Do not trim ultrasonic seals from the tube since the entrance of moisture into the tube may cause misfires.

Never drive any vehicles over Nonel® shock tube. Rupturing or damaging the tube may also cause misfires.

Be sure all Nonel® shock tube connections are at right angles to detonating cord trunklines to prevent angle cutoffs.

The Nonel® lead must lead to the hole in a straight line and be taut. Tie the knots so that the Nonel® shock tube leading to the collar does not come in contact with the trunkline between the knot and borehole collar.

Place detonating cord trunkline hookups in closed loops and use with crossties. Two paths of initiation will then be available for each Nonel® shock tube connection.

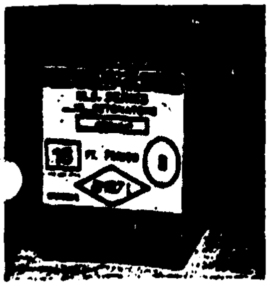
Never attach the primary initiator to the round or shot until after all the connections have been made and the blasting area has been cleared.

DELAY TIMES AVAILABLE

MS Nonel® Primadet® nonelectric delay detonators are available in the following delay intervals:

MS Series
Orange Tube

0-Instant	8-200 msec
1- 25 msec	9-250 msec
2- 50 msec	10-300 msec
3- 75 msec	11-350 msec
4-100 msec	12-400 msec
5-125 msec	13-450 msec
6-150 msec	14-500 msec
7-175 msec	15-600 msec



PACKAGING

Length (ft.)	Units/case	Weight/case (lbs.)
12	500	51
16	400	48
20	300	41
30	200	30
40	125	28
50	100	30
60	100	34
80	100	39
100	75	30
120	75	32

Case dimensions 24" × 17" × 12"

SPECIAL PACKAGE "B"-PACK

8	150	14
12	100	11
16	75	10
20	50	7

Case dimensions 14" × 12" × 7¾"

DISCLAIMERS

ATTENTION

The information and recommendations described in this bulletin cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations herein are based on the manufacturer's experiences, research, and testing. They are believed to be accurate, but no warranties are made, express or implied. Also, the specifications contained herein are all nominals which represent our current production. The product described may be subject to change. Please feel free to contact The Ensign-Bickford Company for verifications.

NO WARRANTIES OR LIABILITIES

The product described herein is sold "as is" and without any warranty or guarantee, express or implied, arising by law or otherwise, including without limitation any warranty of merchantability or fitness for any purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller's negligence or based upon strict products liability or upon principles of indemnity or contribution.

Nonel® Primadet® nonelectric delay detonators are manufactured under U.S. Patent #3,590,739, U.S. Patent #3,125,024 and other patents pending.

The Ensign-Bickford company

Simsbury, Connecticut 06070

Ensign-Bickford Sales Offices:

660 Hopmeadow Street
Simsbury, CT 06070
203/658-4411

Post Office Box 322
207 Pine Creek Rd.
Wexford, PA 15090
412/935-5712

620 Perimeter Drive
Suite 201
Lexington, KY 40502
606/268-2690

5011 Washington Avenue
Evansville, IN 47715
812/476-1329

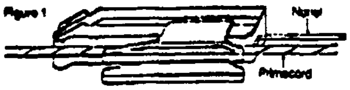
10288 West Chatfield Ave.
Suite 209
Littleton, CO 80127
303/972-3213

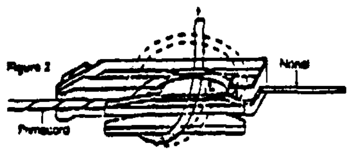
The words Primacord®, Detnacord®, E-Cord®, PD Cord®, Strip Mine Special®, Primadet®, and Primaline®, are registered trademark names and are the sole property of The Ensign-Bickford Company.
Nonel® is a trademark of Nitro Nobel AB of Gyttorp, Sweden.
Zip Cord is a trademark of The Ensign-Bickford Company.

Nonel PG 2
Connectors

TWO WAY CONNECTION

1. Select the location in the trunkline to insert the MS Connector and cut the detonating cord.
2. Place the groove of the connector block about six inches in from one end of the Primacord® detonating cord. The cut end of the trunkline must come out of the same end of the block as the Nonel. (Figure 1)
3. Loop the tail back 270° around the cleat block and lock in place. (Figure 2)
4. Place the tail over the top of the block and push down through the loop formed on the side, or cut the tail so it does not come in contact with the Nonel tube.
5. Pick up the other end of Primacord and connect to the second block in the same manner.
6. *Be sure the tail of the cord does not* contact the Nonel tube.





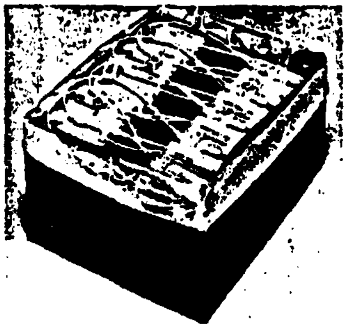
IMPORTANT INSTRUCTIONS

Do not attempt to disassemble the delay cap from the plastic connector block, or use the cap by itself without the block.

MS Connectors *contain* blasting caps and are subject to detonation caused by abuse, such as impact, the same as all caps.

The Nonel tube should not be damaged; moisture entering the tube will *cause failure.*

MS Connectors should be placed close to the hole being delayed to eliminate ground movement cutoffs from the preceding hole.



PACKAGING

Plastic blocks are color coded for delay times. Each shipping box contains 50 MS Connectors. The package weighs 10 lbs. and measures 14" × 12" × 7¾".

DISCLAIMERS

ATTENTION

The information and recommendations described in this bulletin cannot possibly cover every application of the product or variation of conditions under which the product is used. The recommendations herein are based on the manufacturer's experiences, research, and testing. They are believed *to be accurate, but no warranties are* made, expressed or implied. Also, the specifications contained herein are all nominals which represent our current production. The product described may be subject to change. Please feel free to contact The Ensign-Bickford Company for verifications.

NO WARRANTIES OR LIABILITIES

The product described herein is sold AS IS and without any warranty or guarantee, express or implied, arising by law or otherwise, including without limitation any warranty of merchantability or fitness for any purpose. Buyer and user agree further to release and discharge seller from any and all liabilities whatsoever arising out of the purchase or use of any product described herein whether or not such liability is occasioned by seller's negligence or based upon strict products liability or upon principles of indemnity or contribution.

The Ensign-Bickford company

Simsbury, Connecticut 06070

Ensign-Bickford Sales Offices:

660 Hopmeadow Street
Simsbury, CT 06070
203/658-4411

Post Office Box 97
Louviers, CO 80131
303/798-8625

5011 Washington Avenue
Evansville, IN 47715
812/476-1329

Post Office Box 322
Wexford, PA 15090
412/935-5712

5036 Snapfinger Woods Drive
Decatur, GA 30035
404/987-1000

1325 Airmotive Way
Reno, NV 89502
702/786-7822

The MS Connector is manufactured under U.S. Patents #3,987,733 and #4,187,780. Nonel shock tube is manufactured under U.S. Patent #3,590,739.

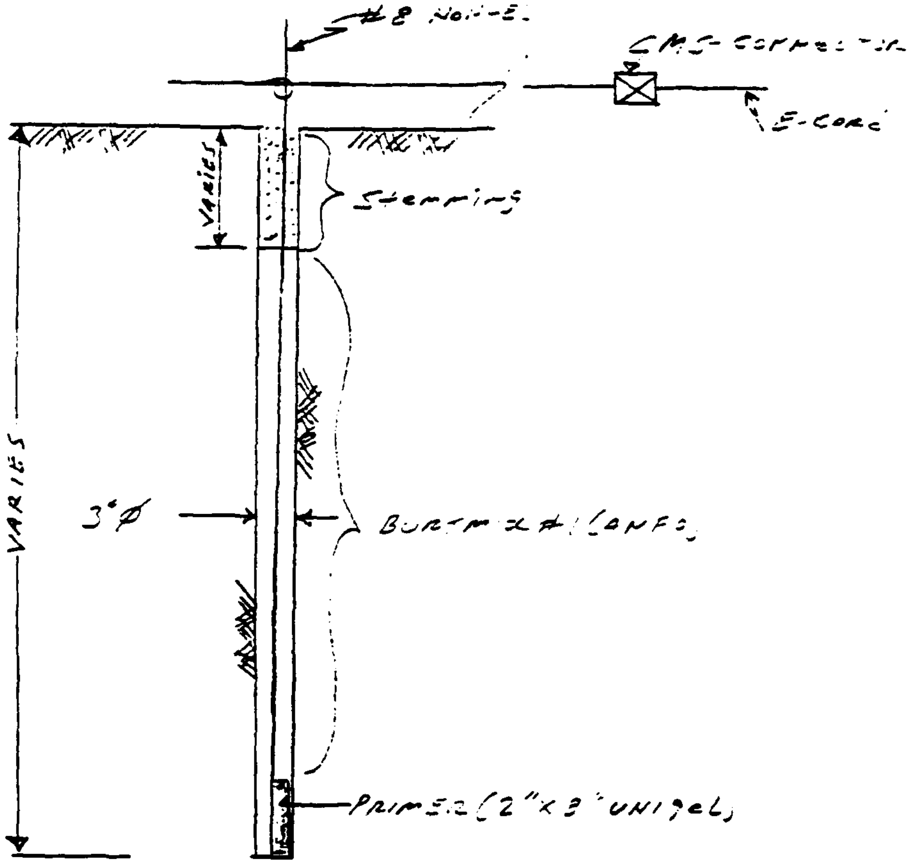
McCaw Drilling & Blasting Ltd.

Reference:

Date:

By:

Sheet 1 of 1



PRODUCTION HOLE (DRY)

M018

McCaw Drilling & Blasting Ltd.

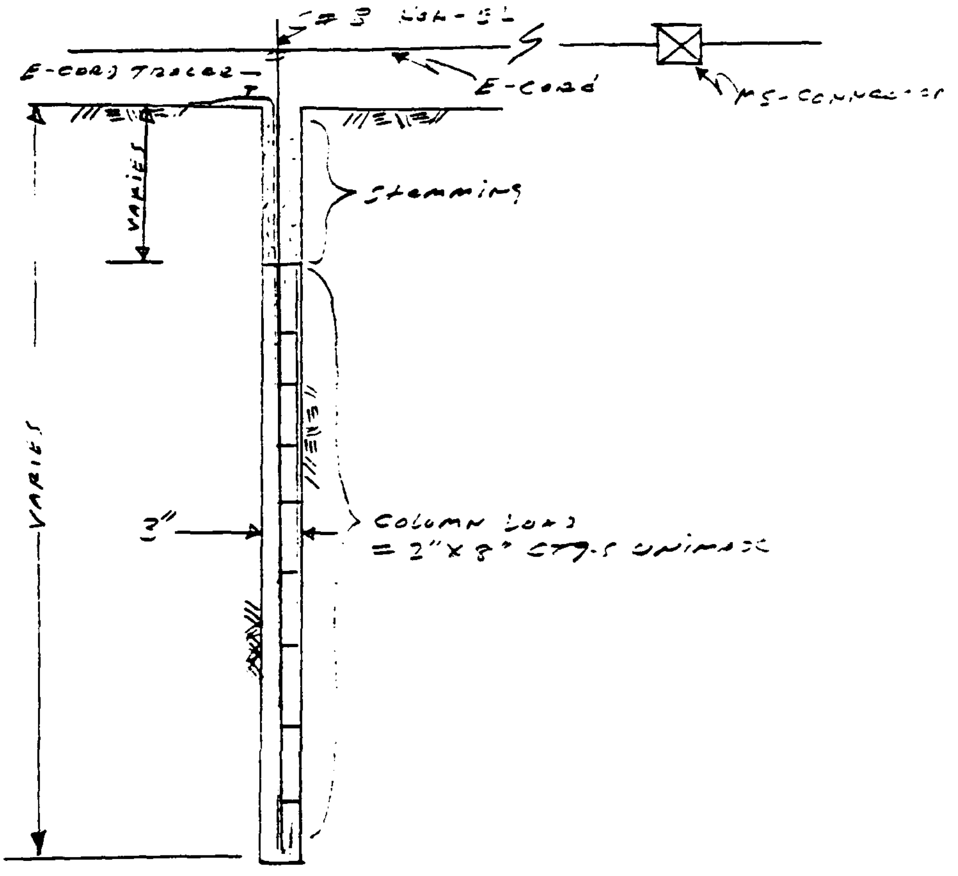
Reference:

Date:

By:

Sheet ___ of ___

TYPICAL COLUMN LOAD



PRODUCTION HOLE/WET

M018

APPENDIX C

MAGAZINE SPECIFICATIONS

1. High Explosive Magazine:
   Type: Type 2 Portable with skids
   Dimensions: 6-1/2' X 7' X 8'
   Capacity: 11,000 lbs.
   Construction: 1/4" steel with interior lining of 2 inches of hardwood, 1-1/2" plywood or particle board.
   Ventilation: Adequate
   Locks: 2 master locks with 7/16" shackles

2. Detonator Magazine:

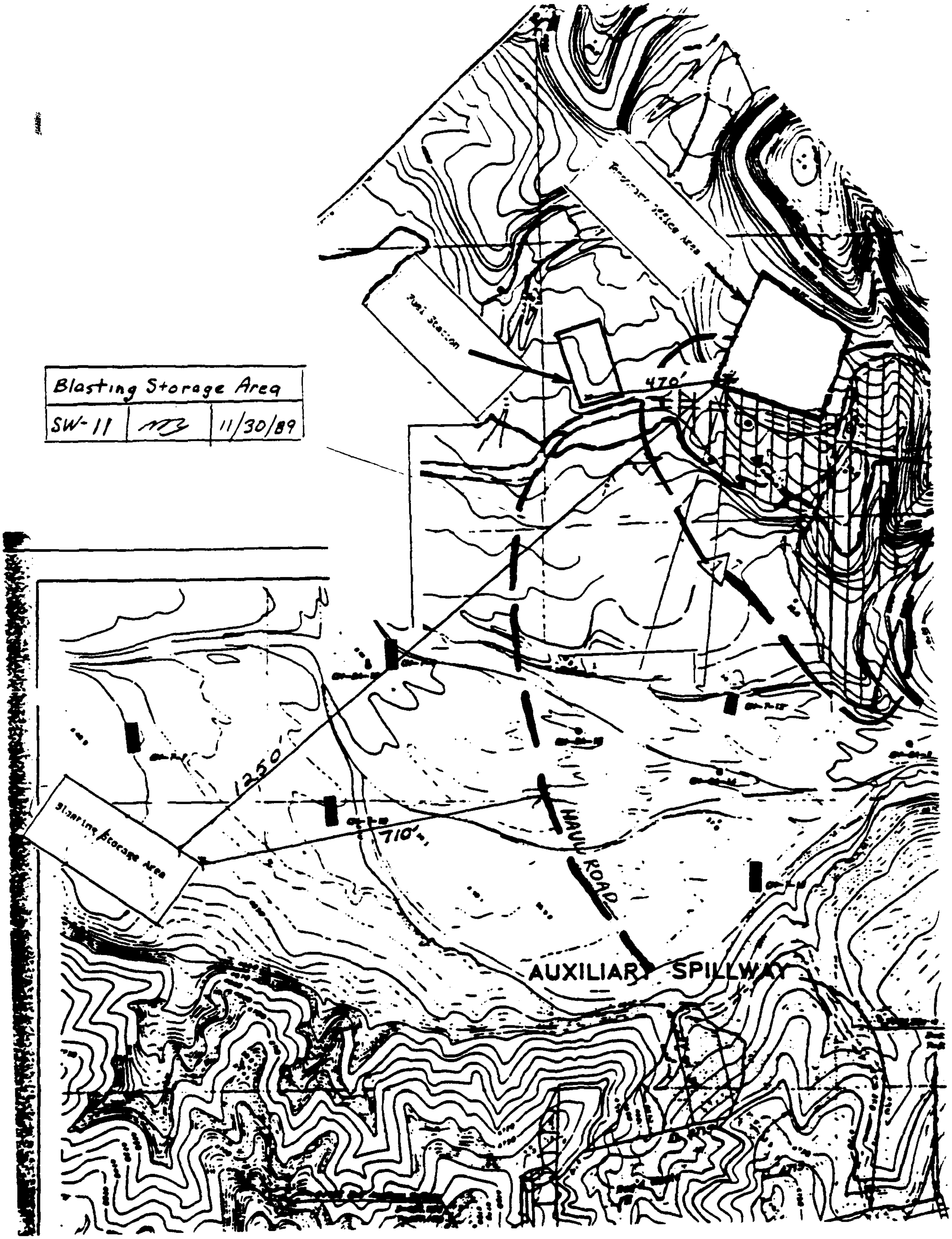
   Type: Type 2 portable with skids
   Dimensions: 6' X 6-1/2' X 7'
   Capacity: 13,000 caps (approximately 25 lbs explosive)
   Construction: 1/4" steel with interior lining of 2 inches hardboard, 1-1/2" plywood, or particle board.
   Ventilation: Adequate
   Locks: 2 master locks with 7/16" shackles

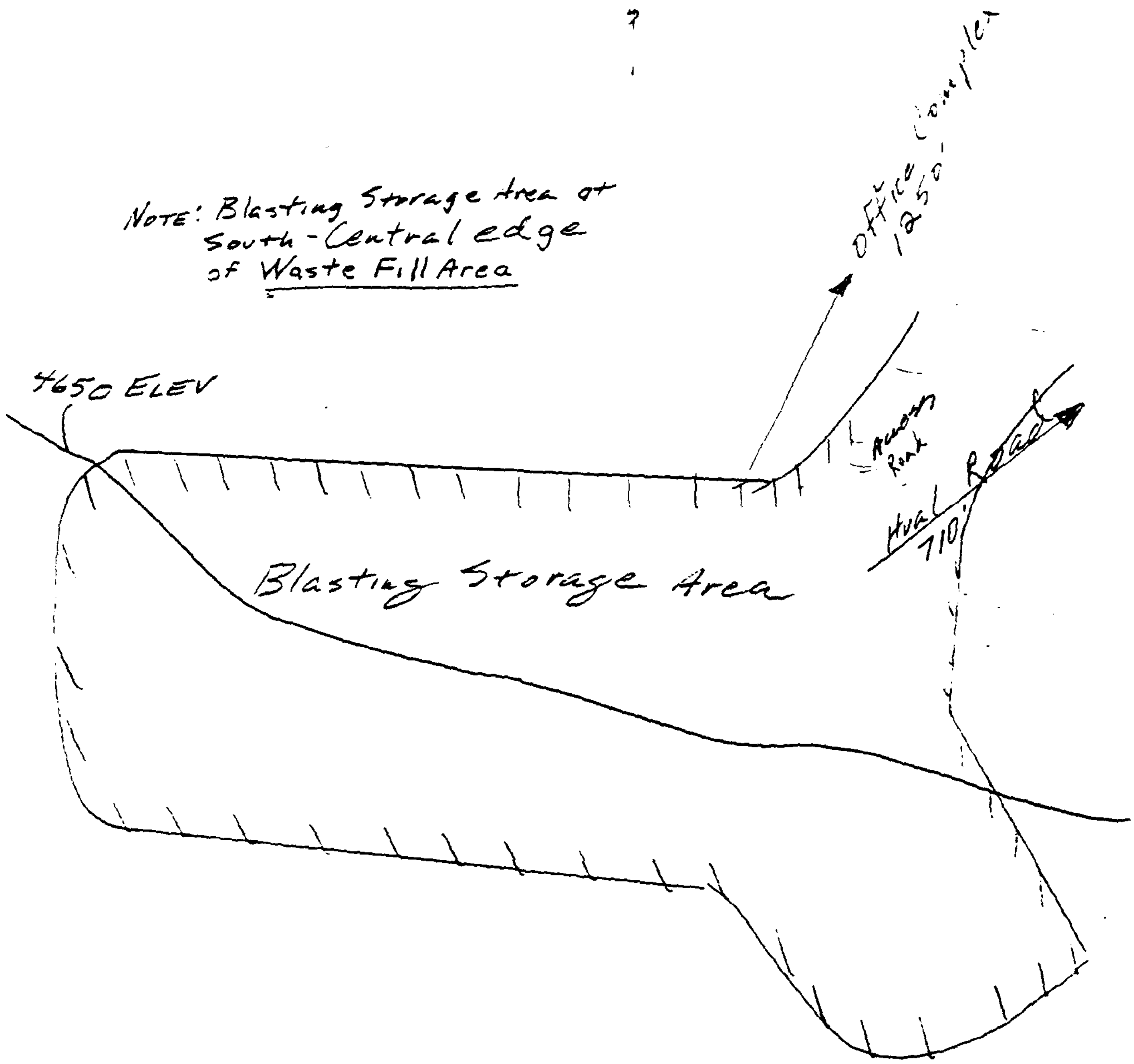
3. Anfo Trailer:

   Type: Type 4 portable
   Dimensions: 8' X 9' X 40'
   Capacity: 45,000 lbs
   Construction: Standard Semi-Trailer
   Ventilation: Adequate
   Locks: Immobilized by king pin lock with locking rear doors.

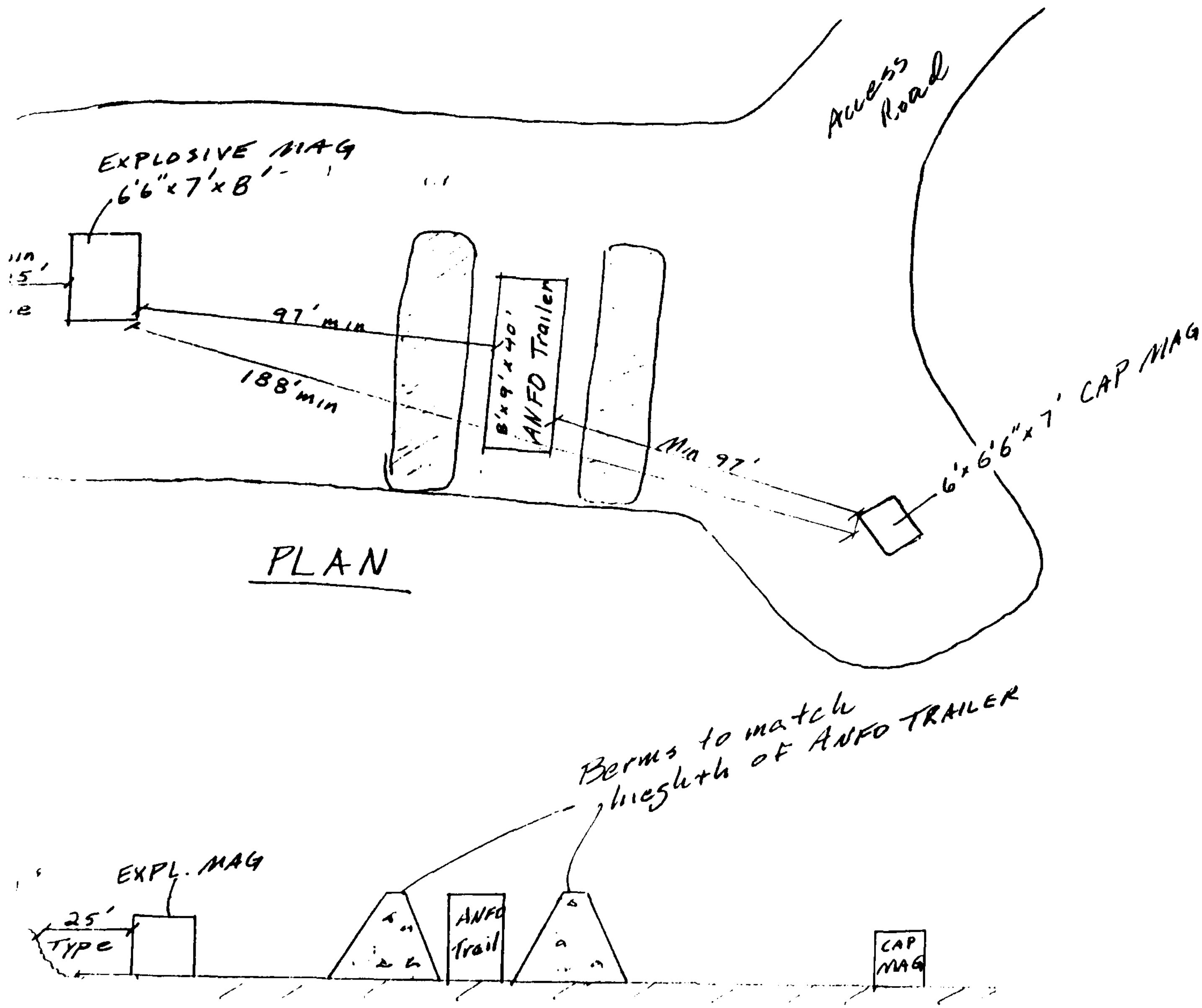
4. Security of Magazines:

   As stated above, all magazines will have locks in accordance with ATF Publication P 5400.7 (11/82) and will be kept locked at all times while unattended. In addition, warning sings will be posted on all sides of the magazine storage location.


Blasting Storage Area
SW-11
11/30/89
Fuel Station
470'
1250'
710'
HAUL ROAD
AUXILIARY SPILLWAY

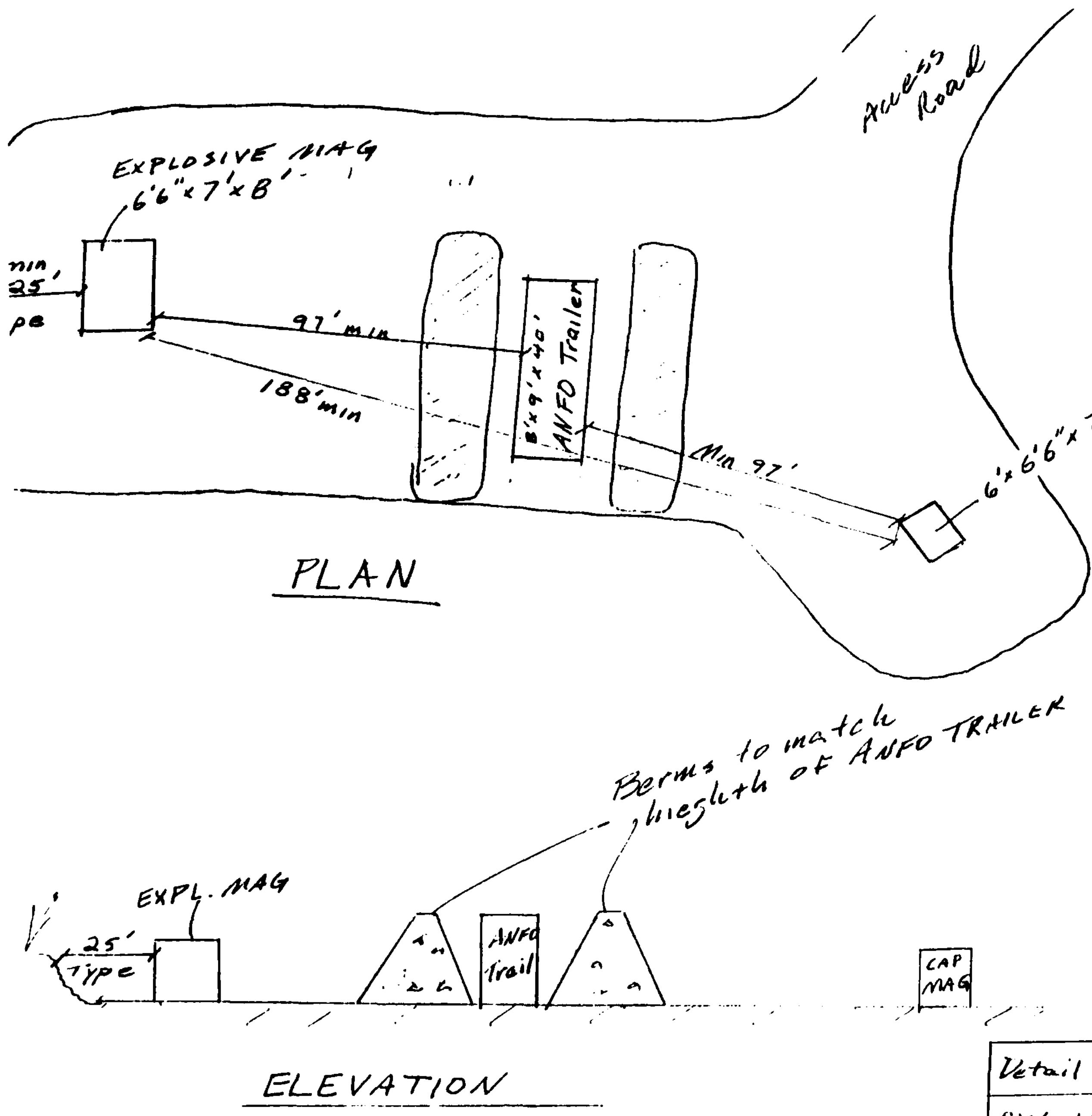


Blasting Storage Area /		
SW-15	NEO	11/20/80



ELEVATION

Detail of Blasting Storage		
SW-13		11/30/89



Detail of Blasting Storage		
SW-13	NS	11/30/89

APPENDIX D

PROJECT

SHOT NO. ____

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE

WIND AND WEATHER

WATER IN HOLES

STEMMING

POWDER TYPE	LBS.

HOLES	SIZE	DEPTH

CAPS	LENGTH	EACH

MAX. POUNDS/DELAY

REMARKS, DAMAGE
FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

BLASTING REPORT

Feed 11K-4-1

PCL CIVIL CONSTRUCTORS, INC.

Construction Since 1906

December 7, 1989

Serial Letter No.: 061/02219/7

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Blasting and Explosive Materials

Gentlemen:

Reference is made to PCL Civil Constructors, Serial Letter No. 052/02219/7 and specifically your Serial Letter No. 019/02219/7, all of which addresses the above subject manner. This letter and the information contained herein will become part of PCL Civil Constructors General Blast Plan. The items are as follows:

Item 1 - Resumes:

At this time, our drilling and blasting subcontractor, McCaw's Drilling, Inc. does not anticipate persons other than Mr. Kevin Joe and Gerald McCaw being the blasters in charge. If for some unforseen condition, another person is put in charge of the blasting operations that person's resume and list of qualifications will be submitted to the Contracting Officer.

Item 2 - General Procedures:

There was indeed a typographical mistake made in Paragraph 4b. It should read "Ensign".

Item 3 - General Procedures:

A new sentence is hereby incorporated into our General Blasting Plan which reads "No blasting will be performed during the hours of darkness".

Item 4 - Pre-Split:

Paragraph 1, 2nd sentence after the words "shall be", the following is hereby inserted:

"24 inches or as approved by the Contracting Officer."

Item 5 - Cushion Blasting:

Pre-split Paragraph 3-C cushion blasting is hereby deleted. The following is added as Section 6, titled, Cushion Blasting.

SECTION 6 - Cushion Blasting

1. There may be instances where the "Cushion Blasting" technique may be used instead of the conventional per-split or pre-shear techniques to achieve wall control. It has been our experience that if there is less than forth feet of burden in front of the pre-shear holes, inferior results are likely because of ground movement. Cushion blasting for wall control may be accomplished by one of the following methods.

   A. The pre-split or line holes are fired concurrently with the production holes but delayed to detonate after the general blast holes per Section 7-3 of the contract documents.

   B. The main cut area is removed prior to blasting the pre-split holes except for a "cushion" or buffer in front of the neat excavation line. The pre-split holes are then fired on an instantaneous delay to achieve the desired smooth wall at the neat excavation line.

   Field conditions will dictate which of the above methods will be used for wall control if the conventional pre-split or pre-shear methods are not feasible.

Pertinent Sections of "The Blasters' Handbook" by the Dupont Company and "The Blasters's Handbook", by Canadian Industries Limited, depicting both of the afore mentioned techniques are enclosed for the Contracting Officer reference.

I trust the additional information presented above will adequately address all of the items requested in Contracting Officers letter. Both PCL Civil Constructors and McCaw Drilling anxiously await written permission to bring explosive products onto the project site.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

enclosure

PROPERTY OF

KEVIN [illegible]

BLASTERS' HANDBOOK

Prepared by the
Technical Service Section
Explosives Products Division
E. I. du Pont de Nemours & Co. (Inc.)
Wilmington, Delaware 19898

G-59

blast holes the same amount with a 50 per cent reduction in explosives load. The explosives should be well distributed in the hole using decks and detonating cord downlines.

Line drilling is best suited to homogeneous formations where bedding planes, joints, and seams are at a minimum. Natural planes of weakness tend to promote shear through the line-drilled holes into the finished wall. Therefore, thin-bedded, sedimentary, foliated metamorphic formations are not well suited to line drilling for overbreak control unless drilling can be done perpendicular to the strike of the formation. This, however, is not practical in most excavation work.

Figure 22-E shows a typical pattern for line drilling. Best results are obtained when the primary excavation is removed to within one to three rows of holes of the neat excavation line. The last row, or rows, of holes is then slabbed away from the line drill holes using delay caps or MS Connectors. This procedure gives maximum relief in front of the finished wall, allows the rock to move forward, and creates less back pressure which could cause overbreak beyond the line drilling.

Line drilling is very limited in application. The only place where it is applicable is in areas where even the light explosive loads associated with other controlled blasting techniques may cause damage beyond the excavation limit, or where line drilling is used between loaded holes to promote shearing and guide the preshear line.

Some of the disadvantages are: (1) unpredictability except in very homogeneous formations; and (2) high drilling costs because of the close spacings required.

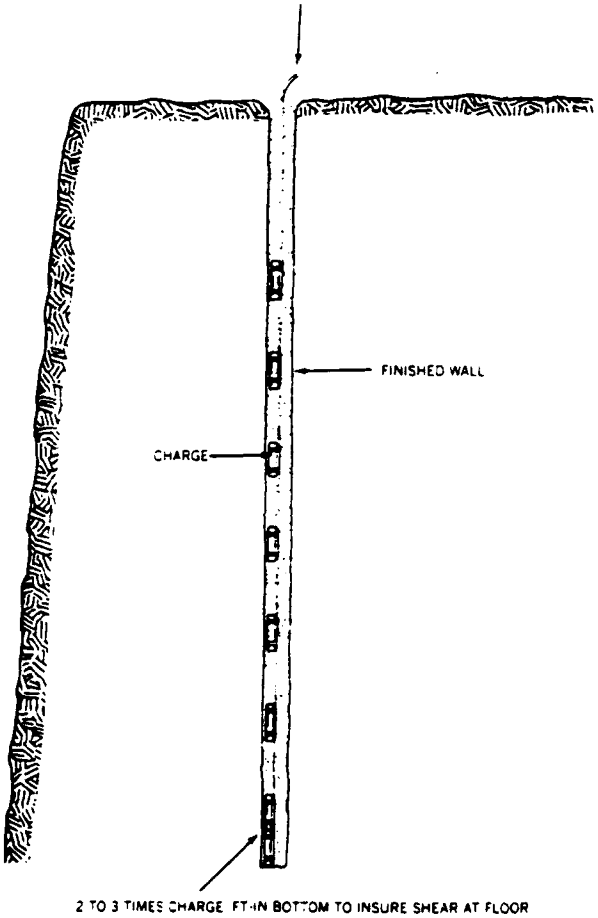
CUSHION BLASTING

Principle. Cushion blasting — sometimes referred to as trimming, slabbing, or slashing — was introduced in Canada. Like smooth wall blasting, a single row of holes is drilled along the neat excavation line, loaded with light, well-distributed charges, and fired after the main excavation is removed. Unlike smooth wall blasting, the annular space in the holes is filled with crushed stone the entire column length. This "cushions" the shock from the finished wall as the berm is blasted and minimizes the stresses and fractures in the finished wall. This technique is seldom used today because the air annulus around the small-diameter charges generally produces equal results and reduces the loading time. The only application for cushion blasting today is in the situation where large-diameter cartridges are taped on detonating cord downlines at planned intervals. The cushion holes are fired with minimum delay between holes. This shears the rock web between holes and yields a smooth wall with minimum overbreak. Detonating cord trunk lines or instantaneous caps are used to initiate on detonating cord downlines if noise is a problem.

The fact that the main cut area is removed in cushion blasting

leaves a minimum buffer (or berm zone) in front of the neat excavation line. The cushion holes can either be drilled prior to any primary blasting or by removing the final berm.

The burden and spacing will vary with the hole diameter being used. The burden-to-spacing relationship will vary with different for-



For maximum cushioning, place charges as close as possible to the excavation side.

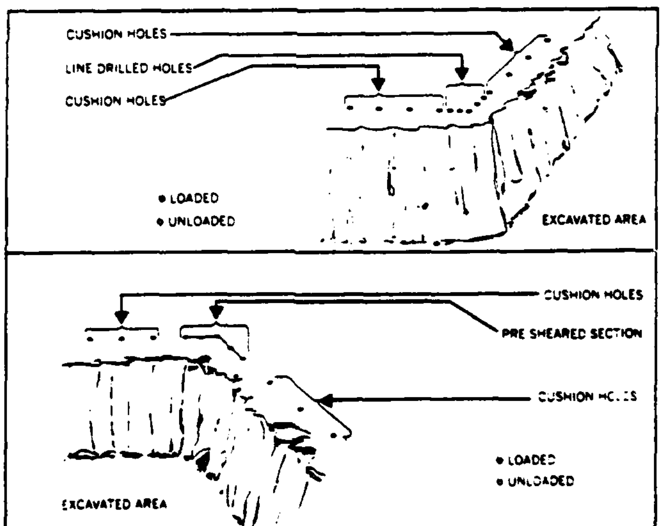
mations, but the spacing should always be less than the width of the berm being removed to obtain maximum shearing between holes.

When a full-length, detonating-cord downline is preassembled by taping the charges on it, the stemming is added after placement of the entire charge. In this case sand, crushed stone, or gravel can serve as stemming provided that it is sufficiently free flowing. Raising and lowering the downline slightly as the stemming is added will help fill the space between the cartridges. The top two or three feet of the hole should be completely stemmed and not loaded. How much top stemming is required will vary with the formation that is being shot.

When cushion blasting around curved areas or corners, closer spacings are required than when blasting a straight section. Guide holes also can be used to advantage when blasting nonlinear faces. On 90-degree corners a combination of controlled blasting techniques will give better results than straight cushion blasting.

In many sedimentary formations where it is difficult to hold a smooth wall, unloaded guide holes between cushion holes are recommended. Generally, small-diameter guide holes are employed to reduce drilling costs.

Where only the top of the formation is weathered, the guide holes need to be drilled only to that depth and not to the full depth of the cu[illegible]n holes. This procedure is common on the first lift or bench since



Guide holes can also be used to advantage when blasting nonlinear faces. On 90-degree corners a combination of controlled blasting techniques will provide better results.

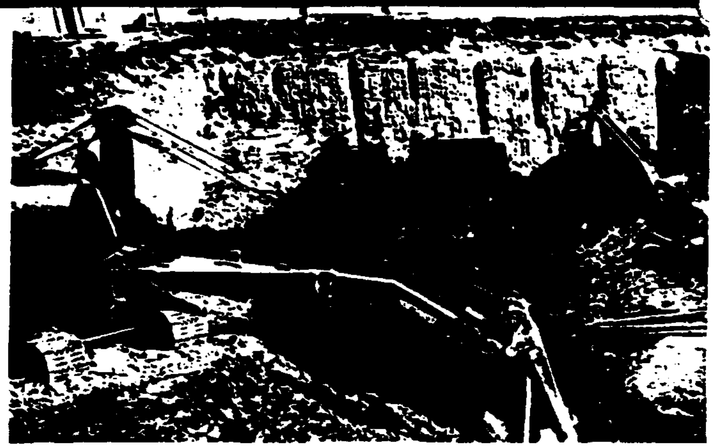
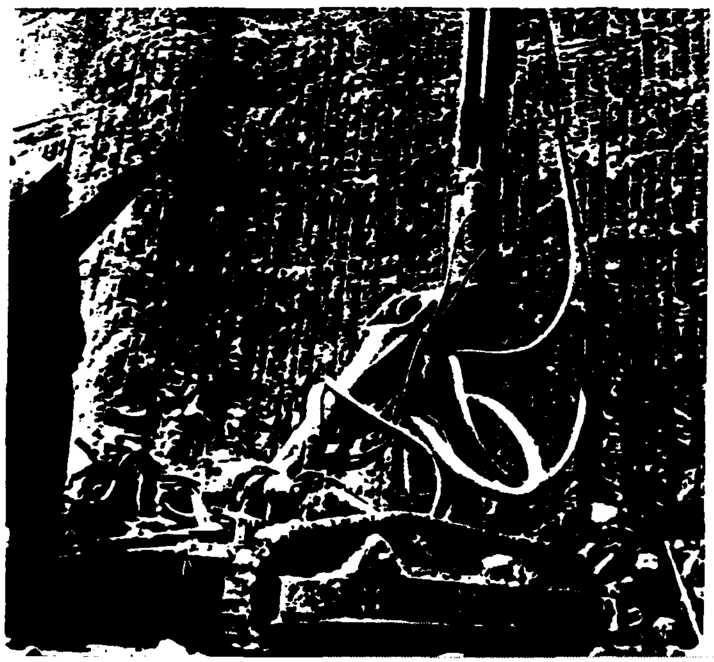


Figure 22-F. Results of cushion blasting where guide holes are drilled to full depth.

backbreak is more probable there than on lower benches. Figure 22-F shows results of a combination of cushion blasting and guide holes where the latter were drilled to full depth. Figure 22-G shows results of cushion blasting using smaller diameter holes and unloaded guide holes.

Cushion blasting in open work has application to inclined and vertical holes. In both cases good hole alignment is essential.

Figure 22-G. Results of cushion blasting with smaller holes and unloaded guide holes.



Blasters'

Handbook

Describing

Practical Methods of Using Explosives

for Various Purposes

•

Prepared by

TECHNICAL MARKETING SERVICES — EXPLOSIVES

Sixth Edition

CANADIAN INDUSTRIES LIMITED

Explosives Division

MONTREAL, QUE.

G-64

against injury to personnel or damage to equipment or installations.

Firing. Pre-Shear holes must be fired simultaneously to obtain the shearing action from hole to hole. Normally the PRIMACORD downline from each hole is connected to a PRIMACORD trunkline, then the required number of pre-shear holes is fired with a blasting cap attached to the end of the trunkline. If the preshearing is being carried out in an area where vibration control is critical, the pre-shear holes may be fired in groups of sufficient numbers to obtain the shearing action while not exceeding the maximum explosives load that may be fired on any one delay period.

Pre-shearing may be accomplished by shooting the preshear holes ahead of the main excavation or with the primary blasts. The location of the work will generally dictate which of these techniques is most applicable.

Pre-shearing ahead of the main excavation is used in the "solid" such as in highway cuts, power intake canals, foundations, etc., where it is useful to define the excavation limits before any other drilling and blasting is carried out. This method should not be used, however, if there is less than 40 feet of burden in front of the pre-shear holes since inferior results are likely because of ground movement. Under the latter conditions, the pre-shear holes should be fired with the primary blasts or the Cushion Blasting technique employed to trim the face after the primary blasting has been completed.

Pre-shearing with the primary blasts is an essential technique in side hill cuts on highways or in quarries and open pit operations where ground movement is likely to occur as a result of firing the pre-shear holes. Ground movement can make drilling of the primary holes difficult or it can be the cause of inferior results if the burden on the pre-shear holes has been reduced to a point that the ground will move during their firing. This method is also used on many operations because it eliminates a step in the drill-blast cycle; it avoids drilling and blasting the pre-shear holes before the main excavation is started. The preshear holes are fired instantaneously, then the holes in the pri-

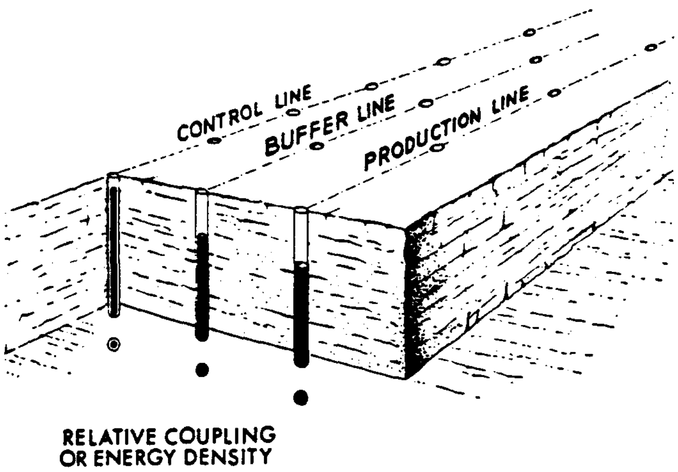


Fig. 296 Principles of wall control to protect a Pre-Shear face.

mary blasts follow, delayed on later firing periods to the open face retreating towards the pre-shearing.

Precautions should be taken to guard against cut-offs in the row of holes immediately in front of the pre-shear face when using this method of firing since ground movement can be severe in this area in blocky ground. The aforementioned row of primary holes should be top and bottom primed to provide adequate insurance against the possibility of cut-offs.

Protection of the Pre-Shear Face. Several steps can be taken to improve both pre-shearing results and the pre-shear face during removal of the primary excavation.

Normally a fillet or wedge is left at the toe of the pre-shear face. This can be reduced to a minimum by drilling the row of primary holes in front of the pre-shear face at the proper distance from it. This procedure will also protect the pre-shear face since the latter could be destroyed if the primary holes are placed too close. Conversely, if too great a burden is placed on the primary holes, a "monument" could result, presenting a dan-

Recd 15 Dec 89

PCL

PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

December 15, 1989

Serial Letter No.: 081/SC-24

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Quality Control Representative

Gentlemen:

PCL Civil Constructors, Inc. is submitting for your approval, Mr. Kevin Joe, of McCaw Drilling and Blasting, as Quality Control Representative for drilling and blasting on the Cuchillo Dam Project. Mr. Joe will be under the direction of the Quality Control Systems Manager to assure all drilling and blasting complies with the requirements on the contract plans and specifications. See attached resume for Mr. Joe's qualifications.

Sincerely,

Thomas R. O'Donnell
Project Engineer

MBB:deo

PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

February 16, 1990

Serial Letter No.: 164/022197

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: General Blast Plan
Blasting Supervisor

Gentlemen:

Reference is made to PCL Civil Constructors serial letter no. 052/022197, dated December 1, 1989, which transmitted our General Blast Plan to the Contracting Officer. PCL Civil Constructors hereby requests that the enclosed correspondence from McCaw's Drilling (USA), Inc., be incorporated into our plan.

Sincerely,

Thomas R. O'Donnell
Project Engineer

TRO:deo

McCaw's
DRILLING (USA), INC.

SUITE 3'6
1646 COURT PLACE
DENVER, COLORADO
80202
FAX (403) 845-6410
TELEPHONE (303) 893 1303

February 15, 1990

PCL Civil Constructors
Cuchillo - Negro Dam Project
Truth or Consequences, New Mexico
Fax: 505-743-7836

ATTENTION: Mr. T. O'Donnell

Dear Sirs:

RE: Quality Control Representative in Charge of Drilling and Blasting

In the event of my absence from site my replacement will be Mr. Kevin Stevenson. Mr. Stevenson has been with our firm for over ten years and has worked in every capacity from drilling to project supervision.

During the past five years, Mr. Stevenson has supervised drill and blast crews of up to forty men on various drill and blast projects across Canada including pipelines, highways, quarries and subdivisions.

Mr. Stevenson has worked mostly in Ontario and the Northwest Territories during the past five years. A blaster's certificate is not required in Ontario.

I am enclosing Mr. Stevenson's Northwest Territories blasting certificate with this transmittal.

If you have any questions or comments you may contact me at the site office.

Yours very truly,

McCAW'S DRILLING (USA), INC.

Laurel Harris

for Kevin Joe
Quality Control Representative
Drilling and Blasting

KJ:ldh
Enclosure

Northwest Territories

June 26 19 89

MINING INSPECTION SERVICES

89-005

EXPLOSIVES PERMIT

FORM B

I hereby certify that Kevin STEVENSON

of 5607 - 57th Avenue, Rocky Mountain House, Alberta

is authorized to handle and use explosives in the Northwest Territories. (Subject to such structures or limitations as are shown.)

Permittee

~~Inspector~~ or Deputy Inspector

Limitations

1. Permit expires N/A 19____

2. Other conditions "SURFACE BLASTING ONLY"
NO TAPE FUSES ALLOWED IN THE NORTHWEST TERRITORIES

NWT2281-80/0981

McGraw Drilling & Blasting Ltd.   page 1 of 3

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE 845-3101   FAX 845-64..

FROM: K. Joe

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☑

MR T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

POSTAL CODE

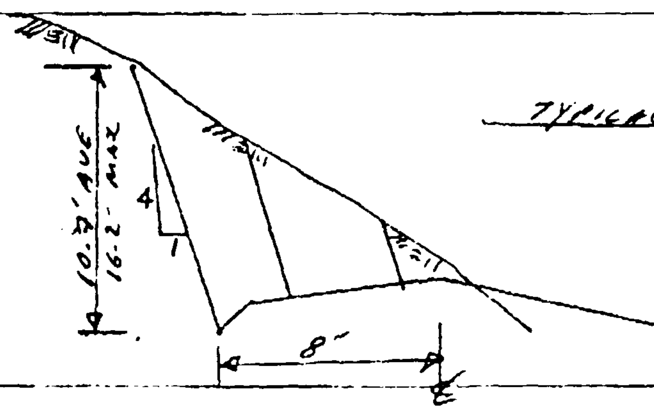
DATE: DEC 21/89

SUBJECT: BLASTING PROPOSAL MAINTAINENCE RD.

MESSAGE

- The Following is a Blasting proposal for The MAINTAINENCE ROAD - REF. DWG. # RG-TC-A-6.1 plate 6.
- PRELIMINARY SITE INSPECTION INDICATES ROCK FROM 10+78 TO 11+50 & FROM 12+50 TO 15+80
- CUTS RANGE FROM 0' TO 16.2' WITH THE AVERAGE CUT ON THE PRE-SPLIT LINE AT 10.7' & DAY LIGHTING NEAR ℄.

REPLY FROM   DATE



TYPICAL SECT

SENDER KEEP PART 2 (YELLOW)   MEMO   RESPONDENT RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES   2249

PHONE 845-3101

FROM: K. JOE

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒

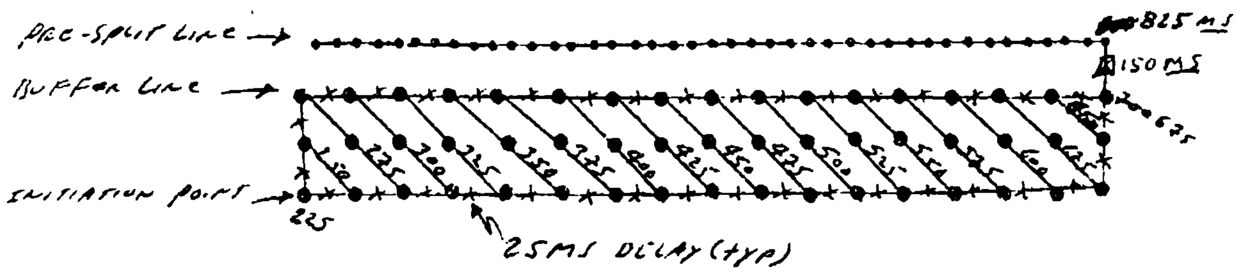
MR. T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

POSTAL CODE

DATE: DEC 21/89

SUBJECT: BLASTING PROPOSAL MAINTAINENCE ROAD

MESSAGE



- TYPICAL TIE-IN DIAGRAM & DELAY SEQUENCE FOR MAINTAINENCE ROAD SHOT.
- MAXIMUM POUNDS PER DELAY SHALL NOT EXCEED 100 Lb.

REPLY FROM DATE

- ALL holes shall be drilled TO DESIGN GRADE IN AN EFFORT TO REDUCE OVERBREAK
- The powder FACTOR shall be REDUCED IN The buffer ROW IN AN EFFORT TO REDUCE IMPACT ON The PRE-SPLIT WALL.

SENDER KEEP PART 2 (YELLOW) MEMO RESPONDENT RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES

McCaw Drilling & Blasting Ltd. — Page 3 of 3

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE 845-3101 FAX 845-3410

FROM: K. Joe

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒

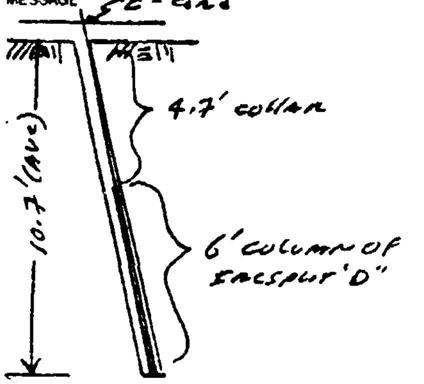
TO: Mr T. O'Donnell
PCL Construction
Cuchillo Dam

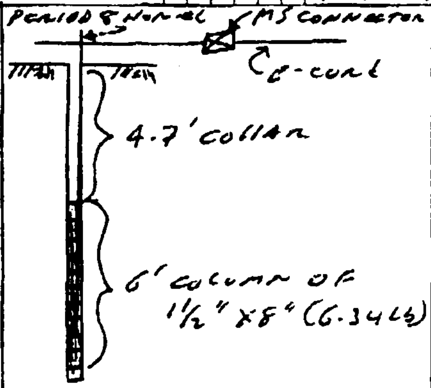
POSTAL CODE

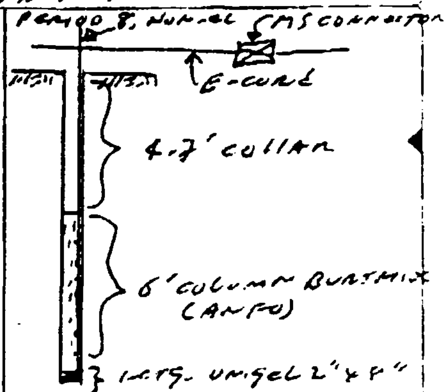
DATE: Dec 21/89 19

SUBJECT: Blasting Proposal
Maintenance Road

MESSAGE







Powder factor = 0.07 lb/S.F.	Powder factor on buffer row = 0.44 lb/cy	Powder factor = 1.13 lb/cy.

REPLY FROM | DATE 19

Pre-split Hole - 2½" Ø	Buffer holes - 3" Ø	Production holes - 3" Ø

* For technical specs on explosives products refer to General Blasting Proposal.

K.J.

SENDER KEEP PART 2 (YELLOW) — MEMO — RESPONDENT RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES

2253

PAGE 1 of 1 PROPOSAL # 90-02

TO MR T. O'DONNELL PCL CONSTRUCTORS CUCHILLO DAM	FROM K. JOE DEPT McCAWS DRILLING DATE JAN 7/90

RE BLASTING PROPOSAL FOR THAT PORTION OF

MESSAGE THE SPILLWAY D/S OF THE DAM AXIS FROM SPILLWAY STATION 2+43.7 TO 4+25

* PLEASE NOTE THAT THIS PROPOSAL IS FOR THE RIGHT AND LEFT ABUTMENTS AT THE ABOVE NOTED STATIONS & SUPERCEDES OUR PROPOSAL FOR THE SPILLWAY D/S OF THE DAM AXIS ON THE RIGHT ABUTMENT DATED DEC 21/89.

K. Joe

REPLY

DATE ______ 19___

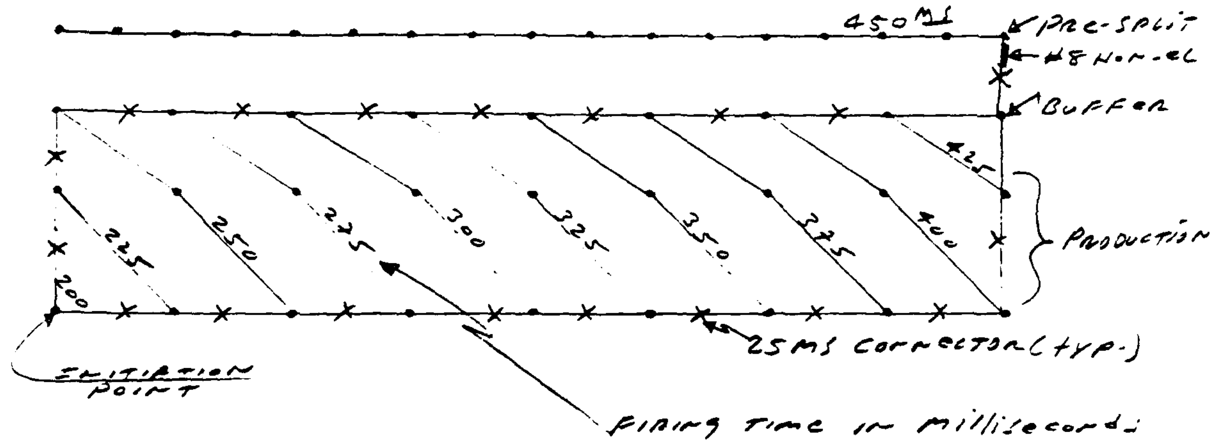
McCaw's Drilling & Blasting Ltd.

Reference: Cuchillo Dam Blasting Proposal # 90-02

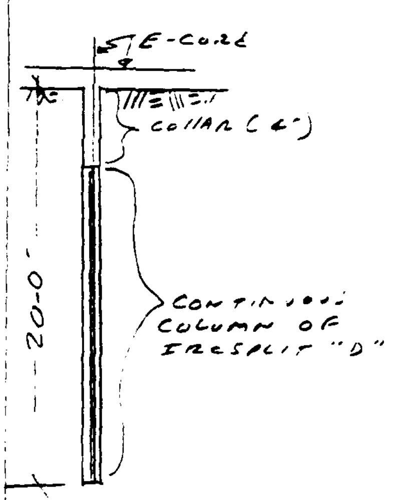
Date: Jan 2/90

By: K.J.

Sheet 4 of 4

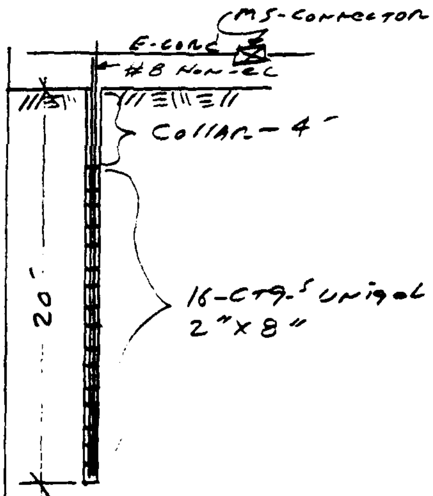


TYPICAL TIE-IN DIAGRAM



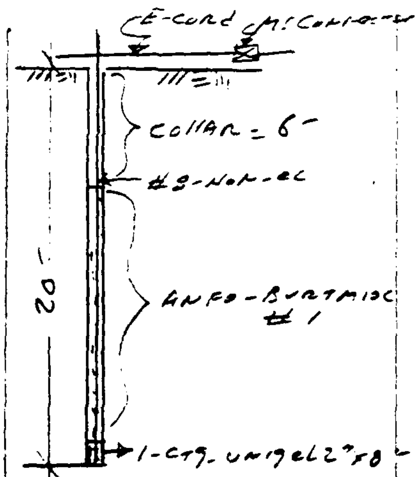
POWDER FACTOR = 0.10 LB/SF

PRE-SPLIT HOLE – 2½" Ø



POWDER FACTOR = 0.77 LB/CY

BUFFER HOLE – 3" Ø



POWDER FACTOR = 0.93 LB/CY

PRODUCTION HOLE – 3" Ø

M018

McCaw Drilling & Blasting Ltd.

Reference: CUCHILLO DAM PROJECT
BLASTING PROPOSAL # 90-02

Date: JAN 7 '90
By: K. [illegible]
Sheet 3 of 4

- DRILL PATTERNS FOR PRODUCTION DRILLING WILL VARY WITH THE DEPTH OF CUT BUT WILL BE IN ACCORDANCE WITH SECT. 4 "PRODUCTION" OF OUR APPROVED GENERAL PROPOSAL & SHALL BE AS FOLLOWS:

3" Ø HOLES

DEPTH	BURDEN	SPACING
UP TO 5'	4'	4'
5' TO 10'	5'	5'
10' TO 15'	6'	6'
15' TO 20'	7'	7'

- THE AMOUNT OF SUB-DRILLING SHALL BE DETERMINED IN THE FIELD AND SHALL BE THAT WHICH YIELDS THE BEST BREAKAGE TO DESIGN GRADE
- THE PRE-SPLIT HOLES SHALL BE 2½" Ø AND SHALL BE DRILLED ON 30" CENTERS OR AS APPROVED BY THE CONTRACTING OFFICER.
- FOR DETAILS OF EXPLOSIVES PRODUCTS USED REFER TO OUR APPROVED GENERAL BLASTING PROPOSAL

M018

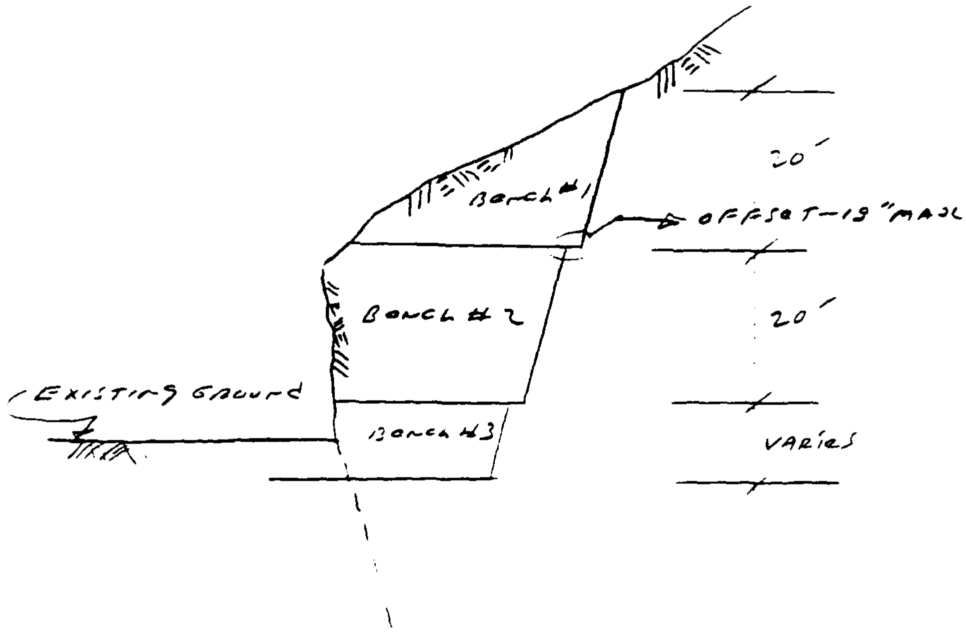
Drilling & Blasting Ltd.

Reference: CUCHILLO DAM PROJECT
BLASTING PROPOSAL # 90-02

Date: JAN 7-90

By: K.J.

Sheet 2 of 4



TYPICAL SECTION & BENCHING SEQUENCE

NOTE: THE GENERAL SEQUENCE SHALL BE AS FOLLOWS:

1) EXCAVATE FROM THE TOP DOWN IN MAXIMUM 20' LIFTS WORKING FROM THE D/S END TO U/S.
2) BLASTING SHALL BE BY THE "CUSHION BLASTING" TECHNIQUE OUTLINED IN OUR APPROVED GENERAL BLASTING PROPOSAL - SECT 6.1.A.
3) THE EXCAVATION BETWEEN STA.S 2+43.7 AND 4+25 SHALL BE COMPLETED TO EL. 4616 THEN THE BENCHES AT EL 4611 & EL. 4607 (2+43.7 TO 3+10.95) EXCAVATED TO DESIGN GRADE

M018

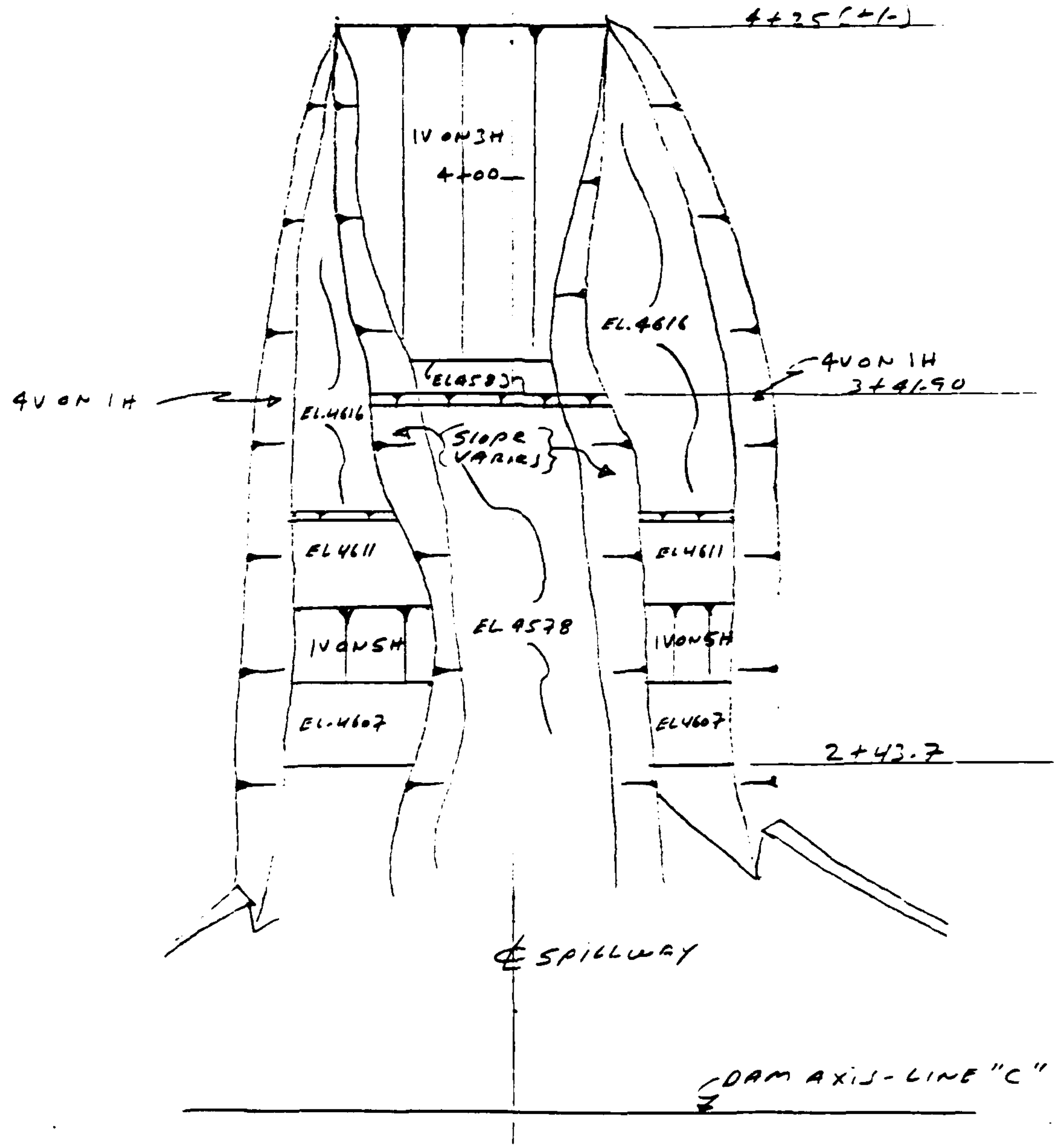
McCaw Drilling & Blasting Ltd.

Reference: CUCHILLO DAM PROJECT
BLASTING PROPOSAL # 90-02

Date: JAN 7-90

By: [illegible]

Sheet 1 of 4



PLAN VIEW OF PROPOSAL AREA

REF. DWG. # RG-TC-A-7.1 PLATE 7

M018

ROCKY MOUNTAIN HOUSE ALBERTA
PHONE 845-3101 FAX 845-6410

FROM: K. JoE

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒

TO: MR T. O'DONNELL
PCL CONSTRUCTORS
Cuchillo DAM

POSTAL CODE

DATE: JAN 8, 1990

SUBJECT: BLASTING PROPOSAL #90-03

MESSAGE

Enclosed for submittal to the Army Corps Administrative contracting officer is our BLASTING proposal #90-03 covering the LEFT Abutment of the DAM, the High Level outlet works & the Low level outlet works.

K. JoE

REPLY FROM

DATE 19

SMEC

SENDER KEEP PART 2 (YELLOW) **MEMO** RESPONDENT RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO 9 AND NO 10 WINDOW ENVELOPES

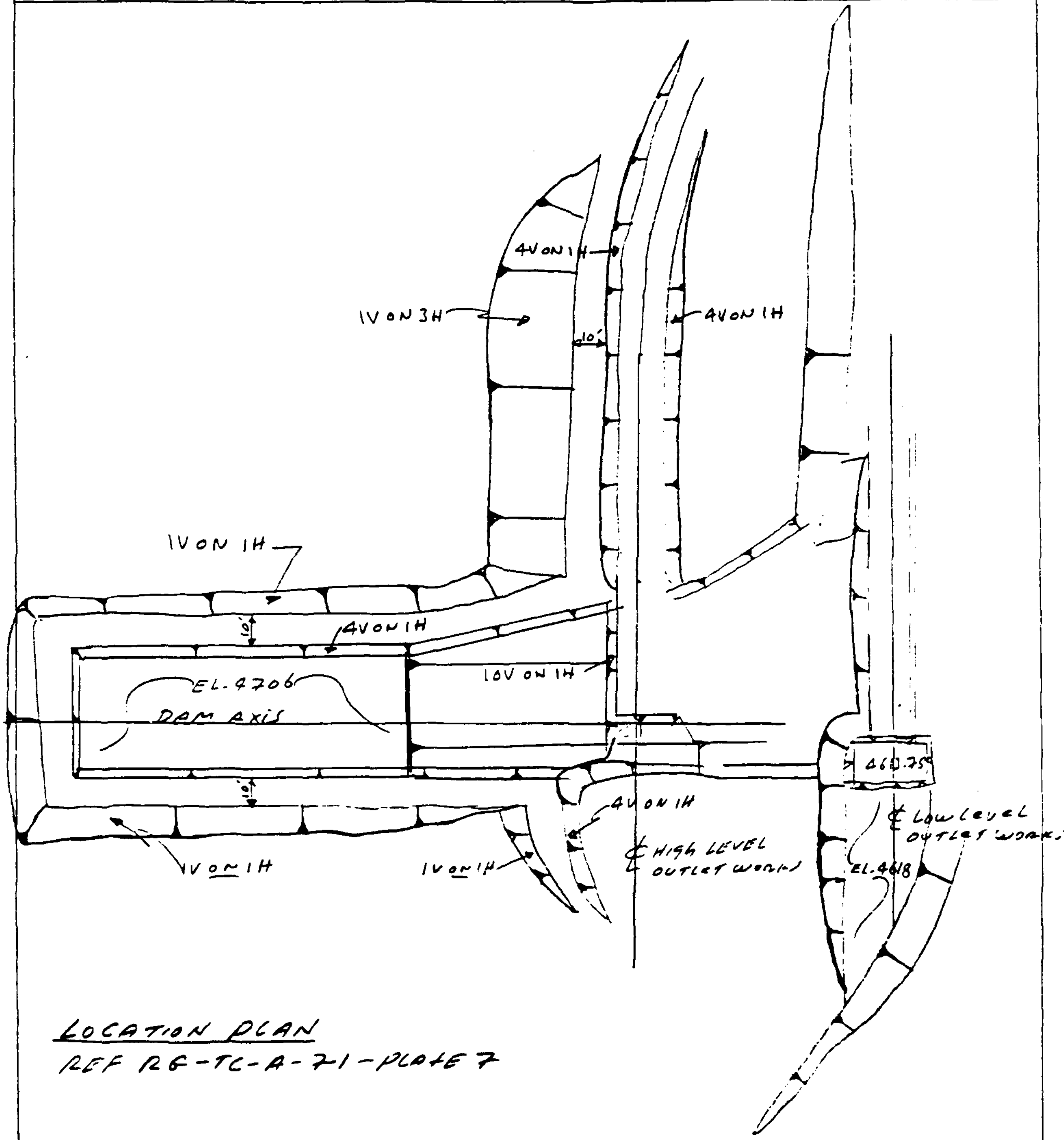
2271

ALPHA OFFICE SYSTEMS

McCaw's Drilling & Blasting Ltd.

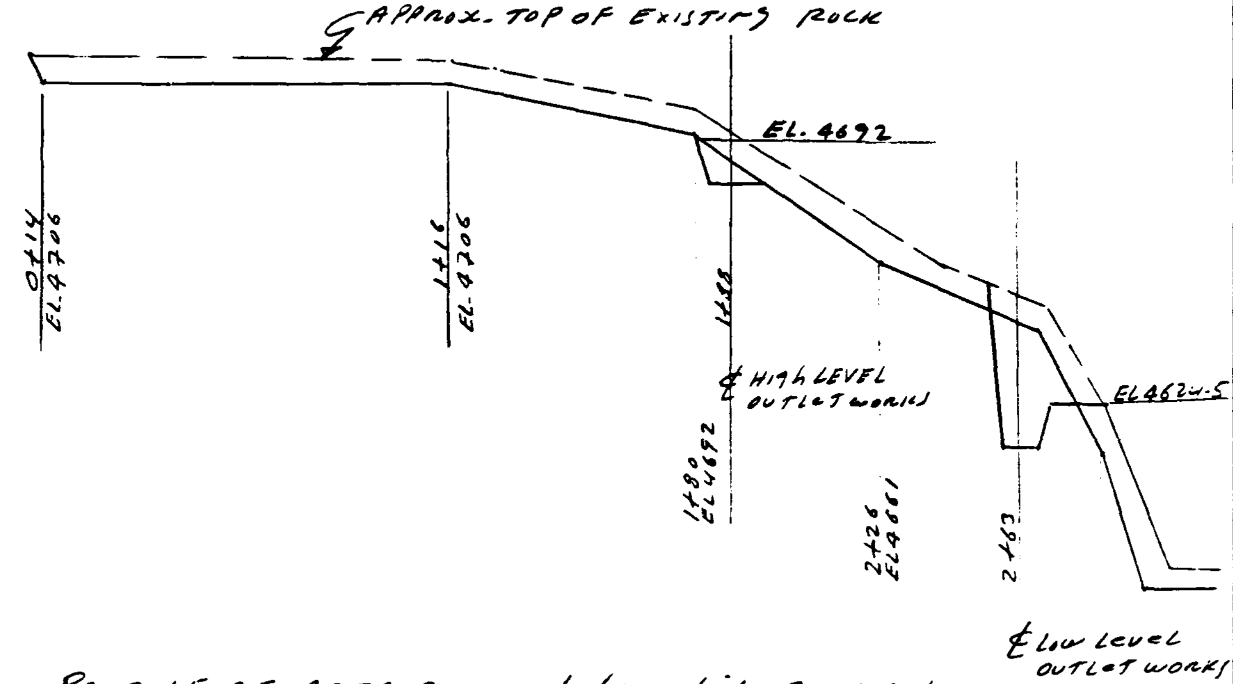
Reference: Cuchillo Dam
Blasting Proposal # 90-03

Date: JAN 8-90
By: K. J.
Sheet 1 of 6



M018

Drilling & Blasting Ltd.	Reference: CUCHILLO DAM BLASTING PROPOSAL # 90-03	Date: JAN 8-90 By: K.S. Sheet 2 of 6



PROFILE OF AREA COVERED BY THIS PROPOSAL

SEQUENCE

- The presplit holes shall be drilled & shot prior to start of production blasting (Dam Abutment)
- The production blasting for the dam abutment shall commence at approximately station 1+91 to EL. 4692 and progress northward to 0+14
- Drilling & blasting of the high level outlet works shall be completed to design grade, including the outlet channel.
- When the drill & blast of the high level outlet works has been completed to design grade drilling & blasting of the dam abutment shall continue to approximately ELEV. 4655
- Drilling and blasting of the low level outlet works shall be completed to design grade, including outlet channel

M018

McCaw's Drilling & Blasting Ltd.

Reference: CUCHILLO DAM
BLASTING PROPOSAL #90-03

Date: JENE/S:
By: K.S.
Sheet 3 of 6

SEQUENCE (CONT. FROM PAGE 2)

- WHEN THE DRILL & BLAST OF THE LOW LEVEL OUTLET WORKS HAS BEEN COMPLETED TO DESIGN GRADE DRILLING & BLASTING OF THE DAM ABUTMENT SHALL CONTINUE FROM EL 4624.5 TO EL. 4578 (+/-)

NOTES

- ALL DRILLING & BLASTING SHALL BE IN ACCORDANCE WITH OUR APPROVED GENERAL BLASTING PROPOSAL AND SECT 7. "BLASTING" OF THE CONTRACT DOCUMENTS.

- DRILL PATTERNS FOR PRODUCTION DRILLING WILL VARY WITH THE DEPTH OF CUT BUT WILL BE IN ACCORDANCE WITH SECT. 4. "PRODUCTION" OF OUR APPROVED GENERAL PROPOSAL AND SHALL BE AS FOLLOWS:

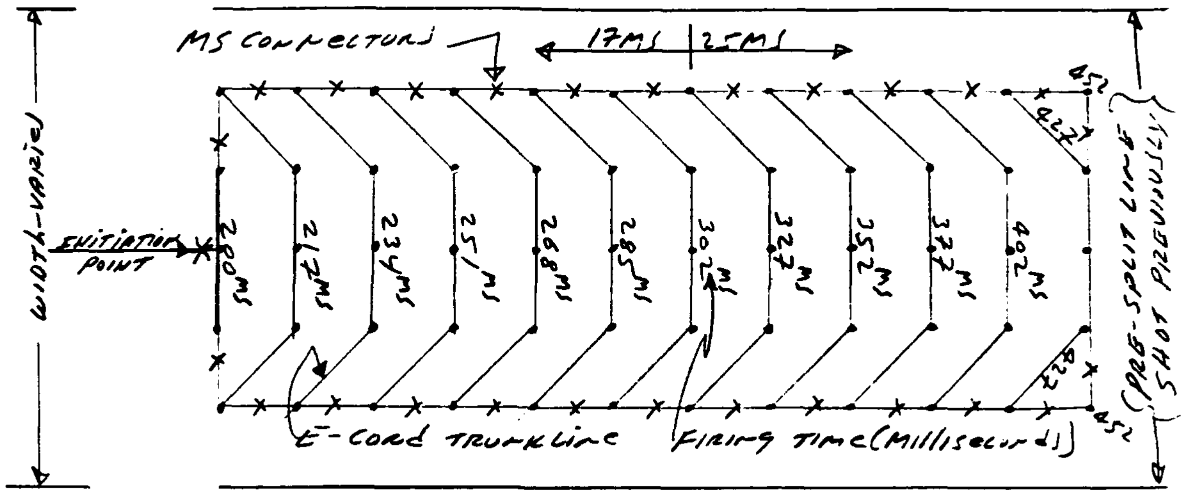
3" Ø HOLES

DEPTH	BURDEN	SPACING
UP TO 5'	4'	4'
5' TO 10'	5'	5'
10' TO 15'	6'	6'
15' TO 20'	7'	7'

- THE AMOUNT OF SUBDRILLING SHALL BE DETERMINED IN THE FIELD & SHALL BE THAT WHICH YIELDS THE BEST BREAKAGE TO DESIGN GRADE.

M018

McCaw's Drilling & Blasting Ltd.	Reference: CUCHILLO DAM BLASTING PROPOSAL #90-03	Date: JAN 8/90 By: K.S. Sheet 4 of 6



- INITIATION BY NON-EL SYSTEM
- PERIOD #8 CAPS IN HOLE
- SURFACE TIE IN & DELAYMENT BY E-CORD & MS CONNECTORS
- MAX LBS PER DELAY SHALL NOT EXCEED 200 LB.

TYPICAL TIE-IN DIAGRAM – PRODUCTION BLAST
(N.T.S)

* LEFT ABUTMENT OF THE DAM (MAX CUT 20')

M018

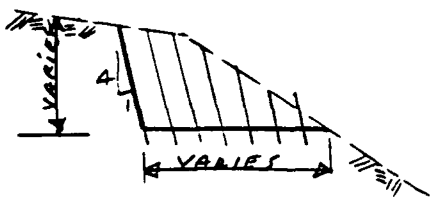
McCaw's Drilling & Blasting Ltd.

Reference: CUCHILLO DAM BLASTING PROPOSAL #90-03

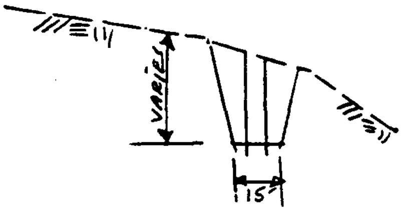
Date: JAN 8-90

By: K.S.

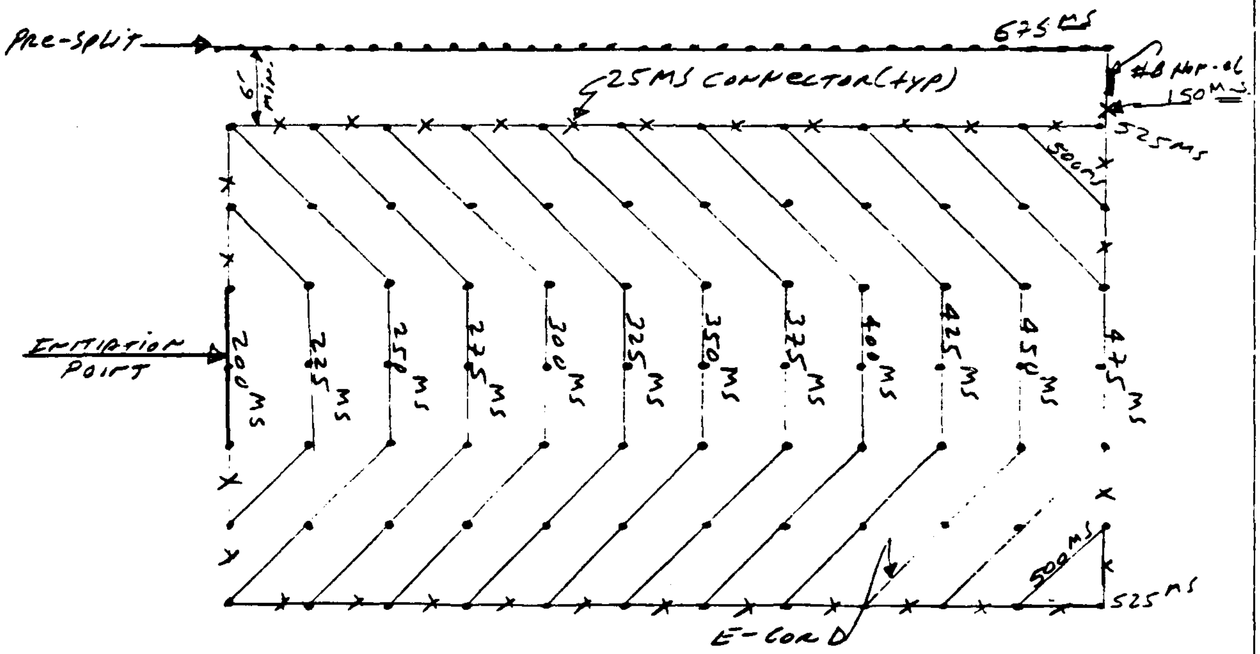
Sheet 5 of 6



TYPICAL SIDE-HILL SECTION
HIGH LEVEL OUTLET WORKS



TYPICAL THRU-CUT SECTION
HIGH LEVEL OUTLET WORKS



* MAX POUNDS PER DELAY SHALL NOT EXCEED 250 Lb.

TYPICAL TIE-IN DIAGRAM – SIDEHILL SHOT
HIGH LEVEL OUTLET WORKS
& LOW LEVEL OUTLET WORKS

M018

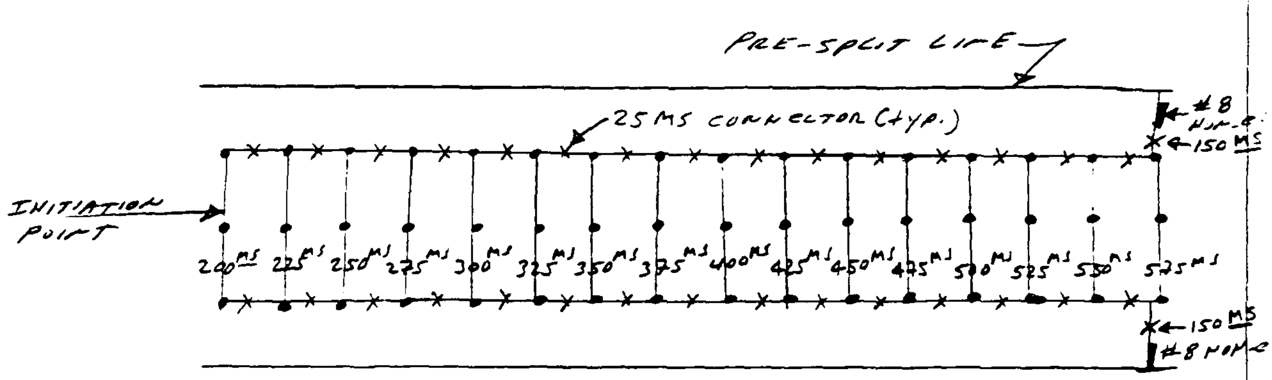
McCaw's Drilling & Blasting Ltd.

Reference: CUCHILLO DAM PROJECT BLASTING PROPOSAL # 90-03

Date: JAN 8/90

By: K.J.

Sheet 6 of 6



* PATTERNS WILL VARY WITH DEPTH OF HOLE BUT IN ANY CASE WILL NOT EXCEED 5'x6'
* PRE-SPLIT HOLES @ 30" C/C OR AS APPROVED BY CONTRACTING OFFICER
* MAXIMUM DEPTH OF HOLE SHALL NOT EXCEED 20'
* MAXIMUM POUNDS PER DELAY SHALL NOT EXCEED 125 LBS.

TYPICAL TIE-IN DIAGRAM FOR THRU-CUT (SECT. PAGE 5)
FOR HIGH LEVEL & LOW LEVEL OUTLET WORKS

Powder FACTORS

- Powder FACTORS will VARY with PATTERN & DEPTH OF CUT but in ANY CASE SHALL NOT EXCEED THE FOLLOWING LIMITS:

(a) PRE-SPLIT HOLES — 0.10 LBS/S.F.
(b) BUFFER HOLES — 1.00 LBS/CY
(C) PRODUCTION HOLES — 1.50 LBS/CY.

M016

McCaw Drilling & Blasting Ltd.

Page 1 of 7
Proposal #90-01

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA TOM 1T0
PHONE 845-3101 FAX 845-6410

FROM: K. Joe

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒

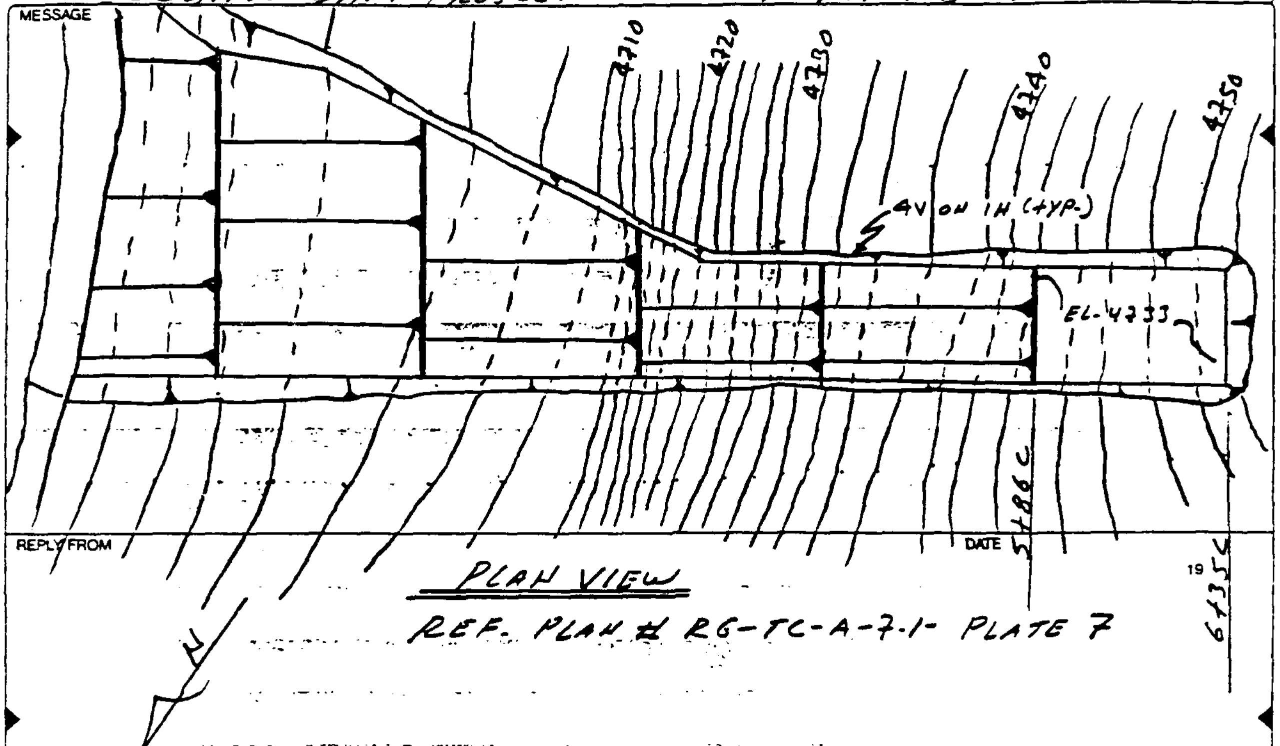
TO: Mr. T. O'Donnell
PCL Constructors
Cuchillo Dam Project

POSTAL CODE

DATE: JAN 5 1990

SUBJECT: Blasting Proposal
Right Abutment - Dam

MESSAGE



PLAN VIEW

REF. PLAN # RG-TC-A-7.1- PLATE 7

REPLY FROM

DATE 19

SMEC

SENDER: KEEP PART 2 (YELLOW) MEMO RESPONDENT: RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES

2255

DRILLING & BLASTING LTD. PROPOSAL #90-01 PHONE 845-3101 FAX 845-641C

FROM: K-JOE

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒

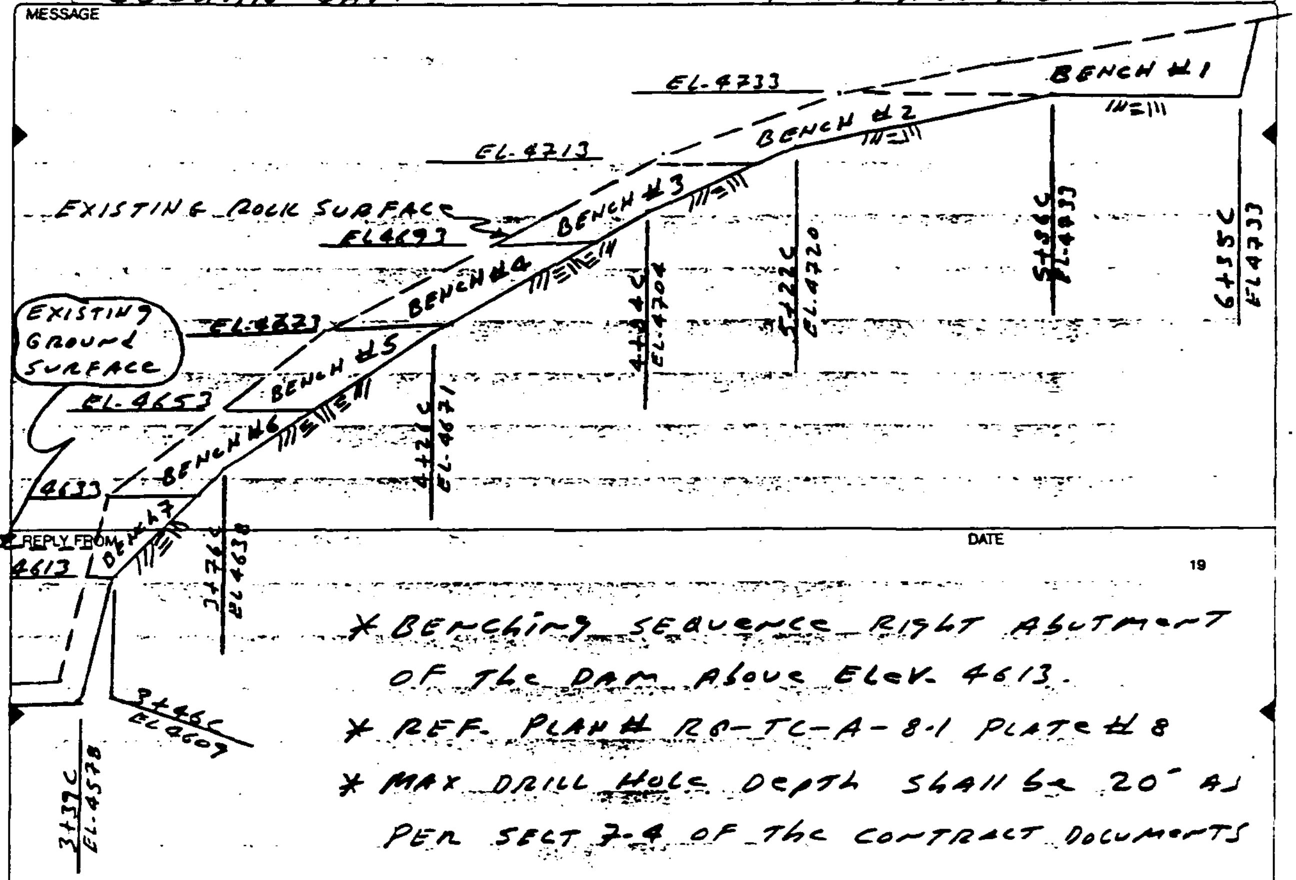
TO: MR T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

POSTAL CODE

DATE: JAN 5-1990 19

SUBJECT: BLASTING PROPOSAL RIGHT ABUTMENT-DAM

MESSAGE



REPLY FROM: DATE 19

* BENCHING SEQUENCE RIGHT ABUTMENT OF THE DAM ABOVE ELEV. 4613.
* REF. PLAN # RO-TC-A-8-1 PLATE # 8
* MAX DRILL HOLE DEPTH SHALL BE 20' AS PER SECT 7-4 OF THE CONTRACT DOCUMENTS

SENDER: KEEP PART 2 (YELLOW) MEMO RESPONDENT: RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES

ALPHA OFFICE SYSTEMS

McCaw Drilling & Blasting Ltd.

PAGE 3 of 7
PROPOSAL #90-01

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE 845-3101 FAX 845-6410

FROM: K-JOE

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒

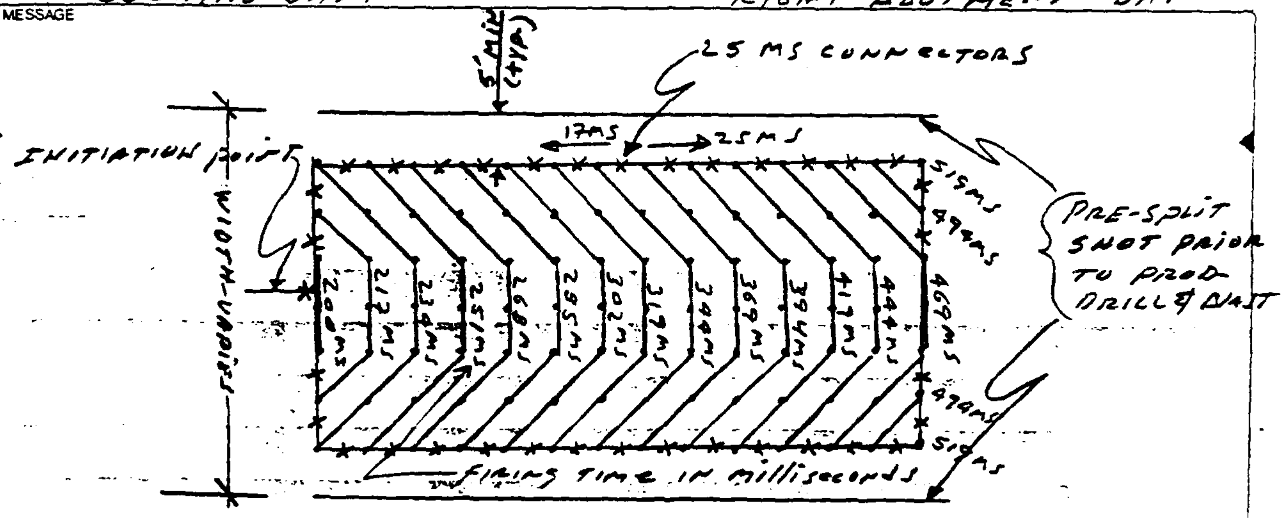
TO: MR T-O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

POSTAL CODE

DATE: JAN 5-1990 19

SUBJECT: BLASTING PROPOSAL
RIGHT ABUTMENT-DAM

MESSAGE



REPLY FROM

DATE 19

TYPICAL PATTERN & TIE-IN DIAGRAM (N-T-S)
AVERAGE CUT = 15-

* MAX. LB. PER DELAY SHALL NOT EXCEED 200 LB.

SENDER KEEP PART 2 (YELLOW) MEMO RESPONDENT RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO 9 AND NO 10 WINDOW ENVELOPES

ALPHA OFFICE SYSTEMS

TO MR T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

FROM K. JOB
DEPT. McCAWS DRILLING
DATE JAN 5, 1990

RE BLASTING PROPOSAL - RIGHT ABUTMENT - DAM

MESSAGE DRILL PATTERNS FOR PRODUCTION DRILLING WILL VARY WITH THE DEPTH OF CUT BUT WILL BE IN ACCORDANCE WITH SECT. 4. "PRODUCTION" OF OUR GENERAL PROPOSAL AND SHALL BE AS FOLLOWS:

3" Ø HOLES

DEPTH	BURDEN	SPACING
UP TO 5'	4'	4'
5' TO 10'	5'	5'
10' TO 15'	6'	6'
15' TO 20'	7'	7'

THE AMOUNT OF SUB-DRILLING SHALL BE DETERMINED IN THE FIELD AND SHALL BE THAT WHICH YIELDS THE BEST BREAKAGE TO DESIGN GRADE.

REPLY DATE 19

MILLER OFFICE GROUP 488-4590 WHEN WRITING SNAP OUT PINK PART — SEND WHITE AND YELLOW INTACT
WHEN REPLYING

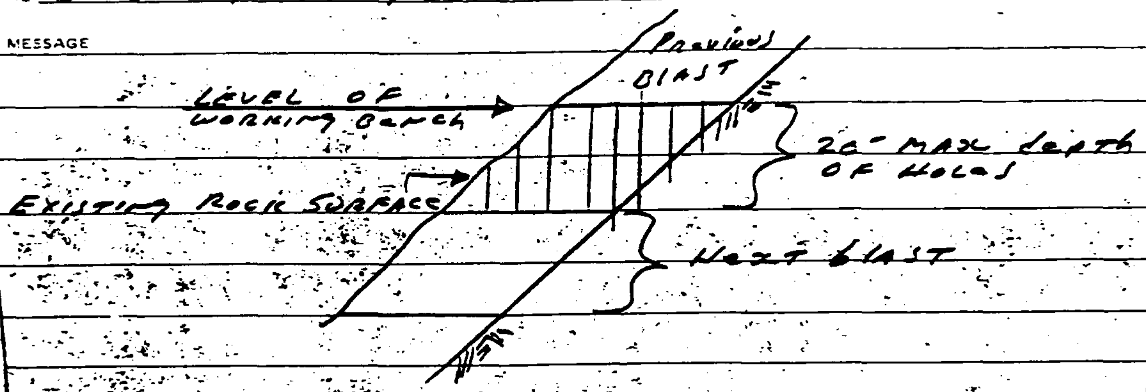
PROPOSAL #90-01

TO: MR T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

FROM: K. JOE
DEPT. McCAWS DRILLING
DATE: JAN 5, 1990

RE: BLASTING PROPOSAL - RIGHT ABUTMENT - DAM

MESSAGE



REPLY

PROFILE THRU TYPICAL BENCH
See PAGE (2) THIS PROPOSAL

19

MILLER OFFICE GROUP — WHEN WRITING SNAP OUT PINK PART — SEND WHITE AND YELLOW INTACT
WHEN REPLYING ... YELLOW ... WHITE

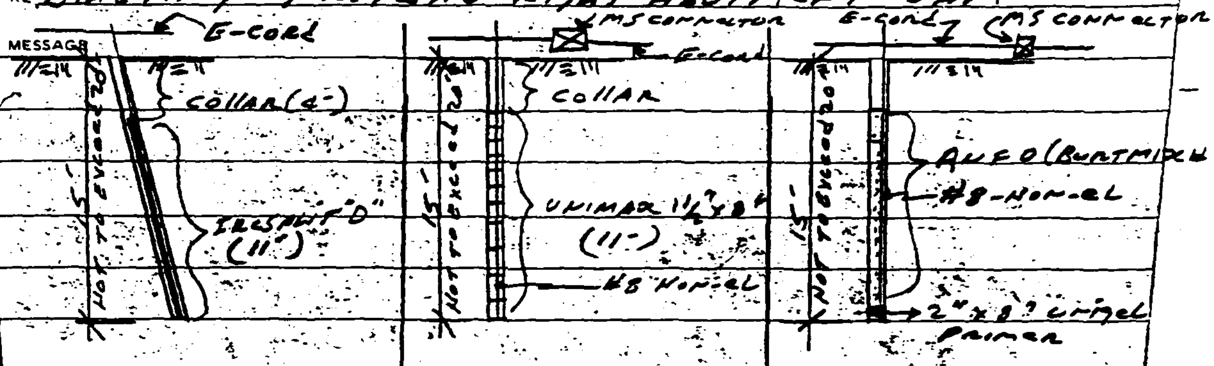
PROPOSAL # 70-01

TO: MR T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

FROM: K. JOE
DEPT: McCAWS DRILLING
DATE: JAN 5, 1990

RE: BLASTING PROPOSAL - RIGHT ABUTMENT - DAM

MESSAGE



2 1/2" Ø HOLE	3" Ø HOLE	3" Ø hole

REPLY

DATE

Powder Factor = 0.09 Lb/SF	Powder Factor = 0.83 Lb/CY	Powder Factor = 1.38 Lb/CY.
PRE-SPLIT HOLES	BUFFER HOLES	PRODUCTION HOLES

TYPICAL COLUMN LOADS FOR AVE. 15' HOLE (MAX 20')

 PROPOSAL #90-01

TO MR T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

FROM K. JOE
DEPT. McCAWS DRILLING
DATE JAN 5-1990

RE BLASTING PROPOSAL-RIGHT ABUTMENT-DAM

MESSAGE Scope & Sequence

- This proposal covers Drilling & Blasting on the Right Abutment (looking D/S) of the dam above El. 4613
- The Pre-split holes shall be Drilled on 30" centers (or as Approved by the Contracting Officer) and Blasted prior to the start of Production Blasting

REPLY

- The Pre-split holes will be kept at least 50' in advance of the production blasting at all times
- The sequence for production benching shall be from top to bottom as shown on page (2) of this proposal
- For details of explosives products refer to our Approved General Blasting Proposal.

MILLER OFFICE GROUP — WHEN WRITING SNAP OUT PINK PART — SEND WHITE AND YELLOW INTACT

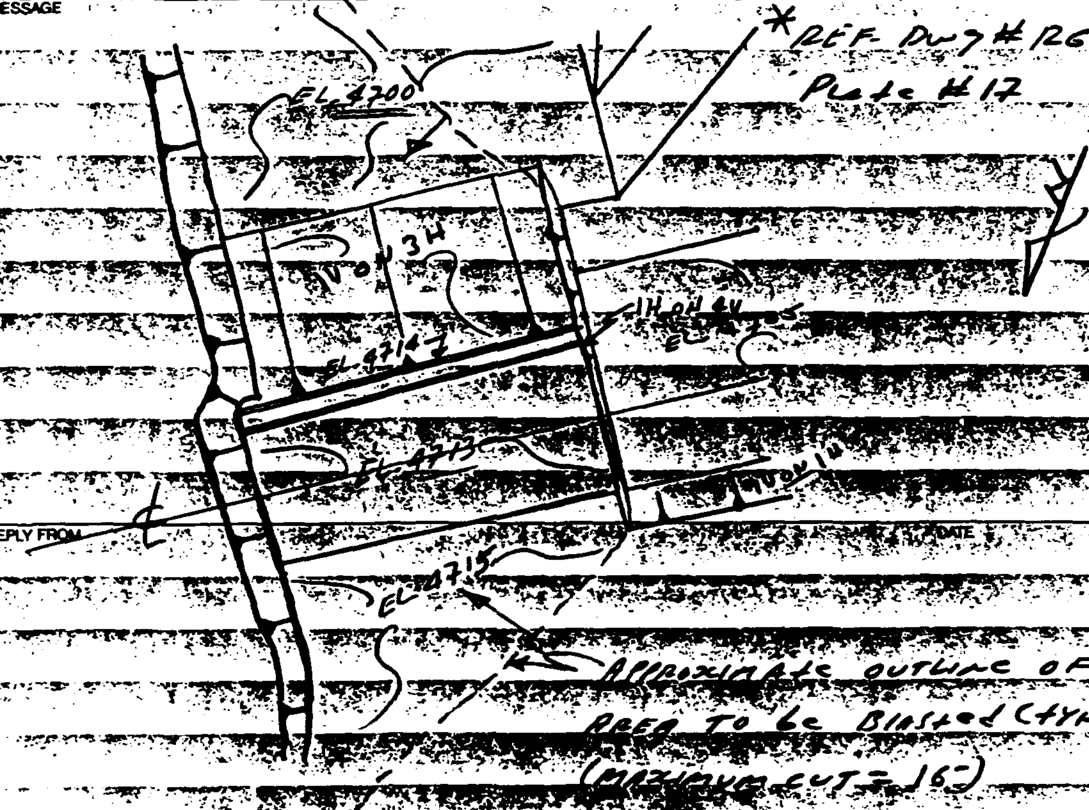
WHEN REPLYING SNAP AND RETURN YELLOW PART — RETAIN WHITE PART AND FILE

DRILLING & BLASTING LTD.

FROM: K. Joe	REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒
TO: MR. T. O'Donnell PCL Constructors Cuchillo Dam Project POSTAL CODE	DATE: Jan 9-1990 19 SUBJECT: Blasting Proposal #90-04 Auxilary Spillway

MESSAGE

*REF. DWG # RG-TC-A-17
Plate #17



LOCATION PLAN

REPLY FROM

DATE 19

SMEC

SENDER: KEEP PART 2 (YELLOW) MEMO RESPONDENT: RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES ALPHA OFFICE SYSTEMS

McGaw Drilling & Blasting Ltd.

PAGE 2 of 3

P.O. BOX 2250
ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE: 845-3101 FAX: 845-6410

FROM K. JOE

REPLY URGENT ☐ AS SOON AS POSSIBLE ☒

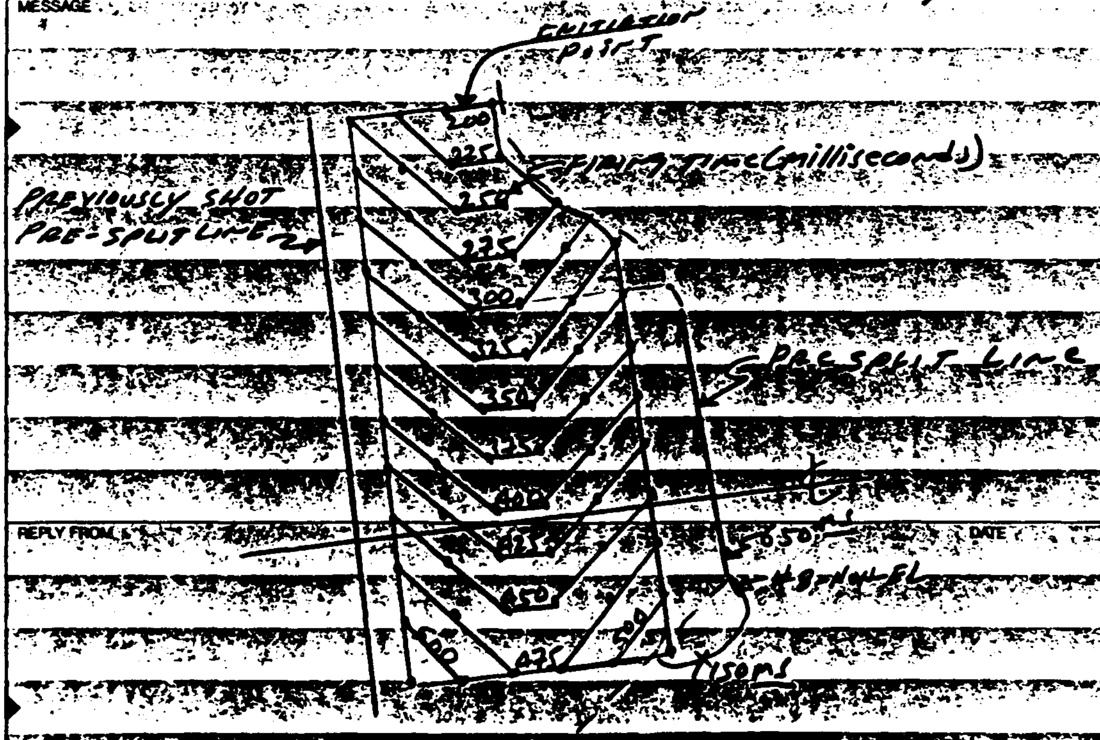
TO MR. T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

POSTAL CODE

DATE JAN 9/90 19

SUBJECT BLASTING PROPOSAL #90-04 AUXILARY SPILLWAY

MESSAGE



GENERAL ARRANGEMENT OF SHOT
N.T.S.

REPLY FROM DATE 19

SENDER: KEEP PART 2 (YELLOW) MEMO RESPONDENT: RETURN PART 3 (PINK)

3227

THIS MEMO FITS STANDARD NO 9 AND NO. 10 WINDOW ENVELOPES ALPHA OFFICE SYSTEMS

PAGE 2-1

DRILLING & BLASTING LTD.

ROCKY MOUNTAIN HOUSE, ALBERTA T0M 1T0
PHONE: 845-3101 FAX 845-6410

FROM: K. JOE

REPLY: URGENT ☐ AS SOON AS POSSIBLE ☒

TO: MR T. O'DONNELL
PCL CONSTRUCTORS
CUCHILLO DAM

POSTAL CODE

DATE: JAN 9/90 19

SUBJECT: BLASTING PROPOSAL #90-04
AUXILARY SPILLWAY

MESSAGE

2½" Φ Pre-Split Hole — 3" Φ Production Hole
P.F. = 0.09 Lb/SF — P.F. 1.00 Lb/CY.

REPLY FROM DATE 19

* PATTERN WILL VARY WITH DEPTH OF CUT BUT IN ANY CASE SHALL NOT EXCEED 8'x8'.
* MAXIMUM LB. PER DELAY SHALL NOT EXCEED 250 LB.
* FOR DETAILS OF EXPLOSIVE PRODUCTS REFER TO OUR APPROVED GENERAL PROPOSAL.

KJoe

SMEC

SENDER: KEEP PART 2 (YELLOW) MEMO RESPONDENT: RETURN PART 3 (PINK)

THIS MEMO FITS STANDARD NO. 9 AND NO. 10 WINDOW ENVELOPES ALPHA OFFICE SYSTEMS

Selected Blast Reports

PROJECT *'AS BUILT

SHOT NO. 1

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW 47-89-C-0056	McCaws Drilling	1+35 (SPILLWAY) SOUTH OF ℄	PRESPLIT
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE ~~C.Y.~~ S.F.	POWDER FACTOR
LIMESTONE	~~375~~ 263	3100 S.F.	~~.12~~ .08 LS/S.F.
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
10:30 AM	2:30 PM	3:00 PM DEC 14/89	[signature]

WIND AND WEATHER
SE @ 10 MPH - CLEAR

WATER IN HOLES
DRILL CUTTINGS & LOCAL GRAVEL

STEMMING

POWDER TYPE	LBS.
PRESPLIT-D	~~375~~ 263

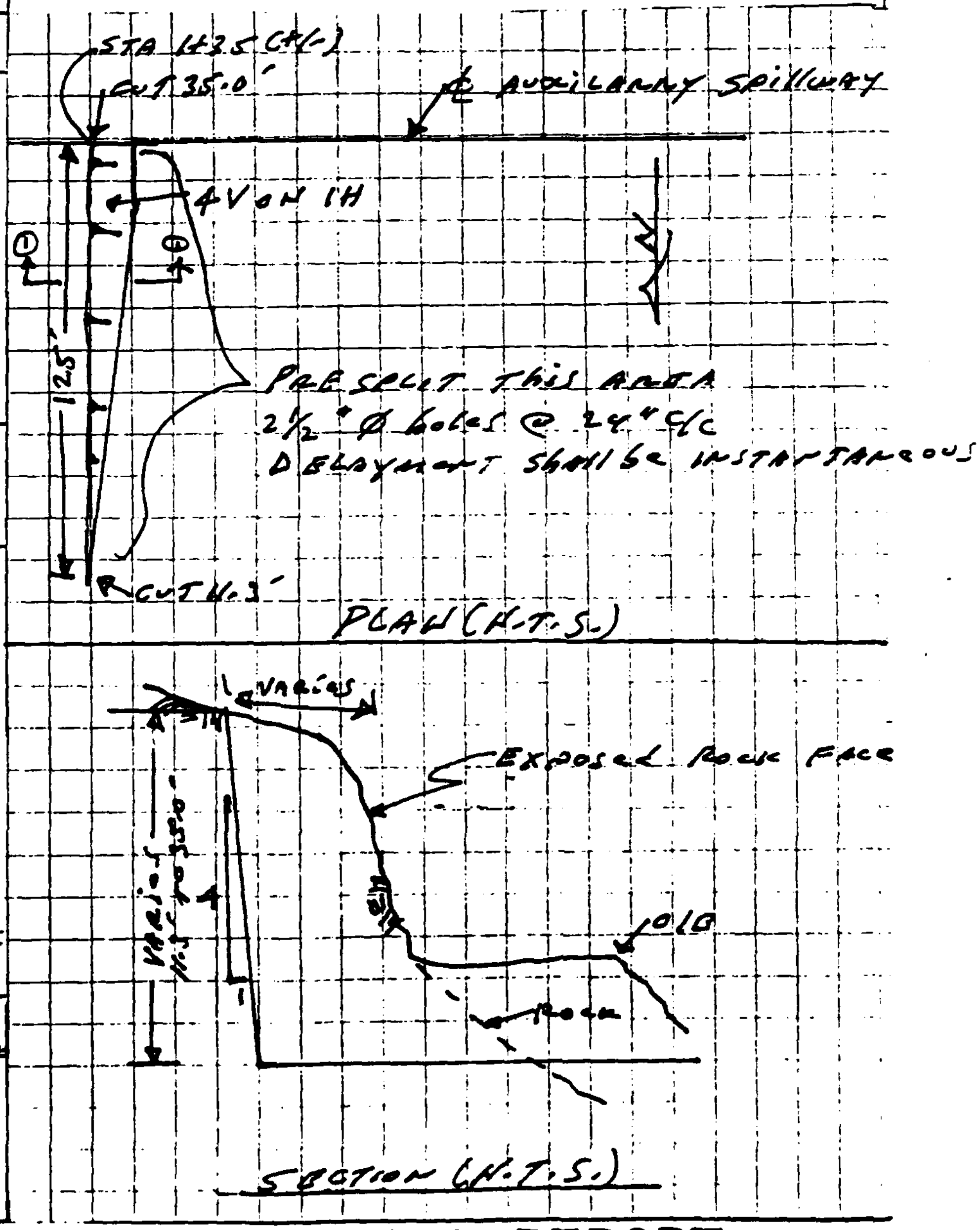
HOLES	SIZE	DEPTH
~~82~~ 60	2½"	23' AVE.

CAPS	LENGTH	EACH
ONE NON-EL	6'	

MAX. POUNDS/DELAY
~~375 LS~~ 263

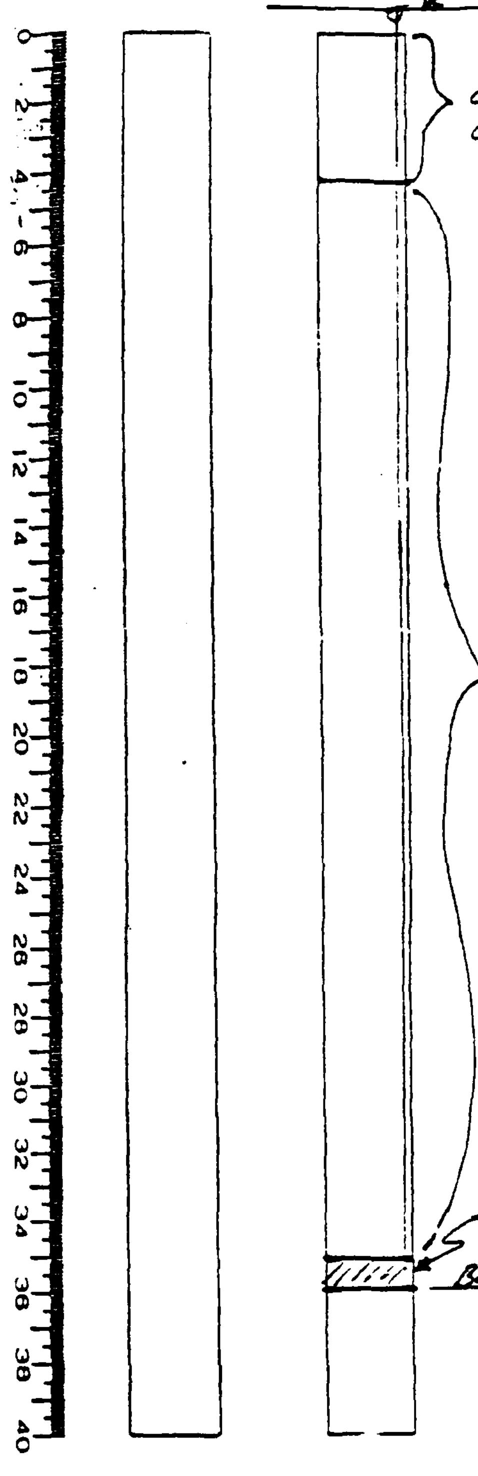
REMARKS, DAMAGE FLYROCK, EVALUATION
ROCK BROKE TO FREE FACE. SOME OVERSIZE

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

TYPICAL LOADED HOLE



[illegible]
HOLE TO HOLE ON SURFACE.
INITIATION BY NON-EL SYSTEM.

COLLAR = 4' MINIMUM - EQUAL STEMMING
(MAY BE INCREASED TO SUIT FIELD CONDITIONS)

* ACTUAL COLLAR WAS 6' TO 8'

CONTINUOUS COLUMN LOAD
OF IREsplit-D WITH E-CORD TRACER
TO BOTTOM OF BORE HOLE.

~~HOS (OF HIGH EXPLOSIVE) (UNIGEL) AS~~
IS ~~TOE LOAD~~
BOTTOM OF BOREHOLE

FOR TECHNICAL SPEC.S ON EXPLOSIVES
PRODUCTS REFER TO GENERAL BLASTING
PROPOSAL, SERIAL LETTER # 052/02219/7

BURDEN 24" c/c

FACING ______ ______

"AS BUILT"

* AS BUILT

SHOT PLAN

PROJECT

SHOT NO. [illegible]

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
[illegible]	McCANS	[illegible]	PRE-SPLIT [illegible]
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
Limestone/ [illegible]	~~[illegible]~~ 500 LS.	7875 S.F.	~~0.09~~ 0.06 LS/SF
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
9:00 AM	5:00 PM	JAN 15-1990 5:26 PM	[illegible]

WIND AND WEATHER: 0/Sunny

WATER IN HOLES: Nil

STEMMING: Drill cuttings

POWDER TYPE	LBS.
Iresplit "D"	~~790~~ 500

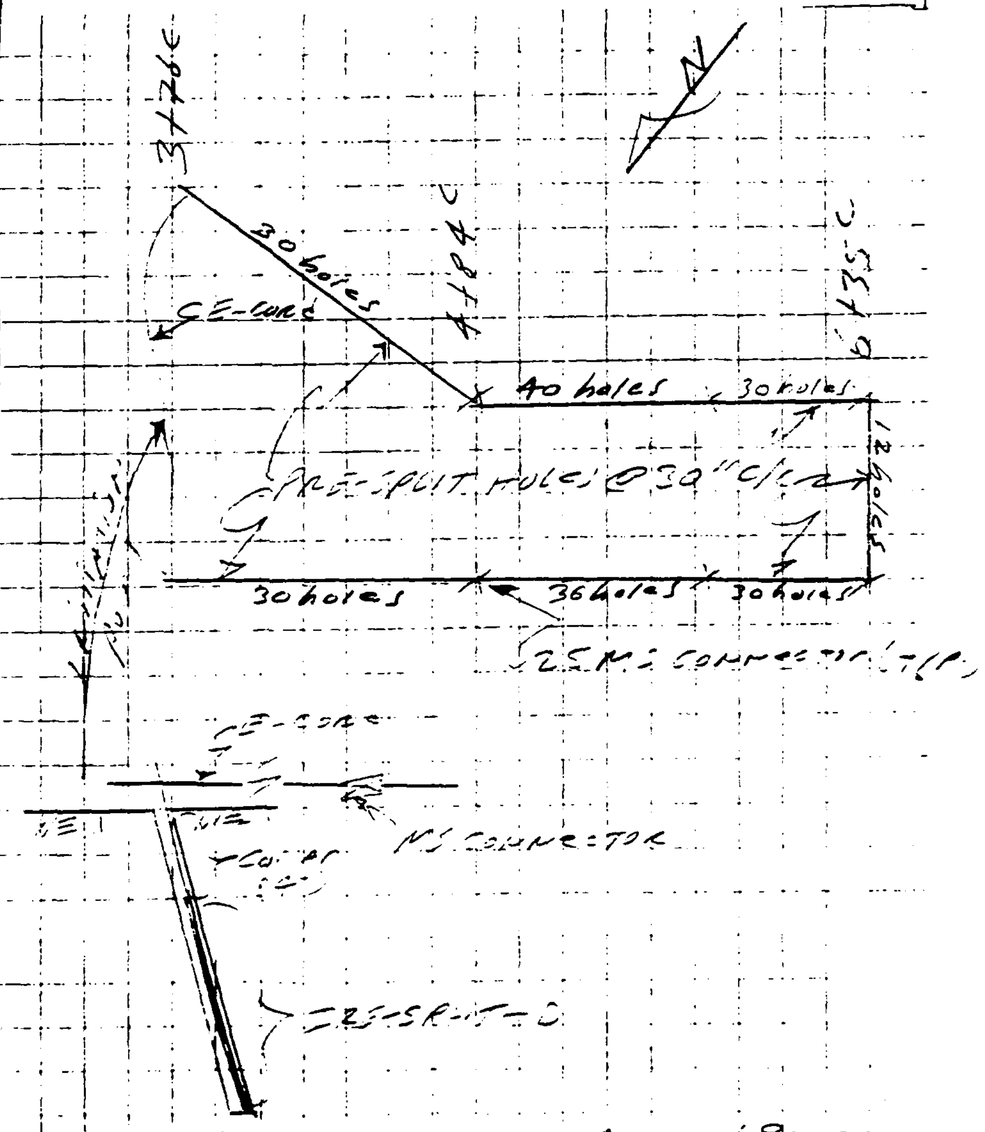
HOLES	SIZE	DEPTH
210 EA	2½"	15' Ave

CAPS	LENGTH	EACH
#8 non-el	12'	one

MAX. POUNDS/DELAY: 11.2 LS

REMARKS, DAMAGE FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



* REF. [illegible] = 90-01

G-98 BLASTING REPORT

PROJECT

SHOT NO. 10

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-3?-?-89-?053	McCAWS	13+50 / 15+00	MAINTENANCE ROAD
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
LIMESTONE	~~1150~~ 800	1090	0.73 ~~1.06~~ LBS/CY
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
10:00 AM	3:30 PM	JAN 20-90 4:15 PM	[illegible]

WIND AND WEATHER
SUNNY - CALM

WATER IN HOLES
NIL

STEMMING
DRILL CUTTINGS

POWDER TYPE	LBS.
IRESPLIT D	150
UNIGEL 2"x9"	100
ANFO	~~900~~ 550

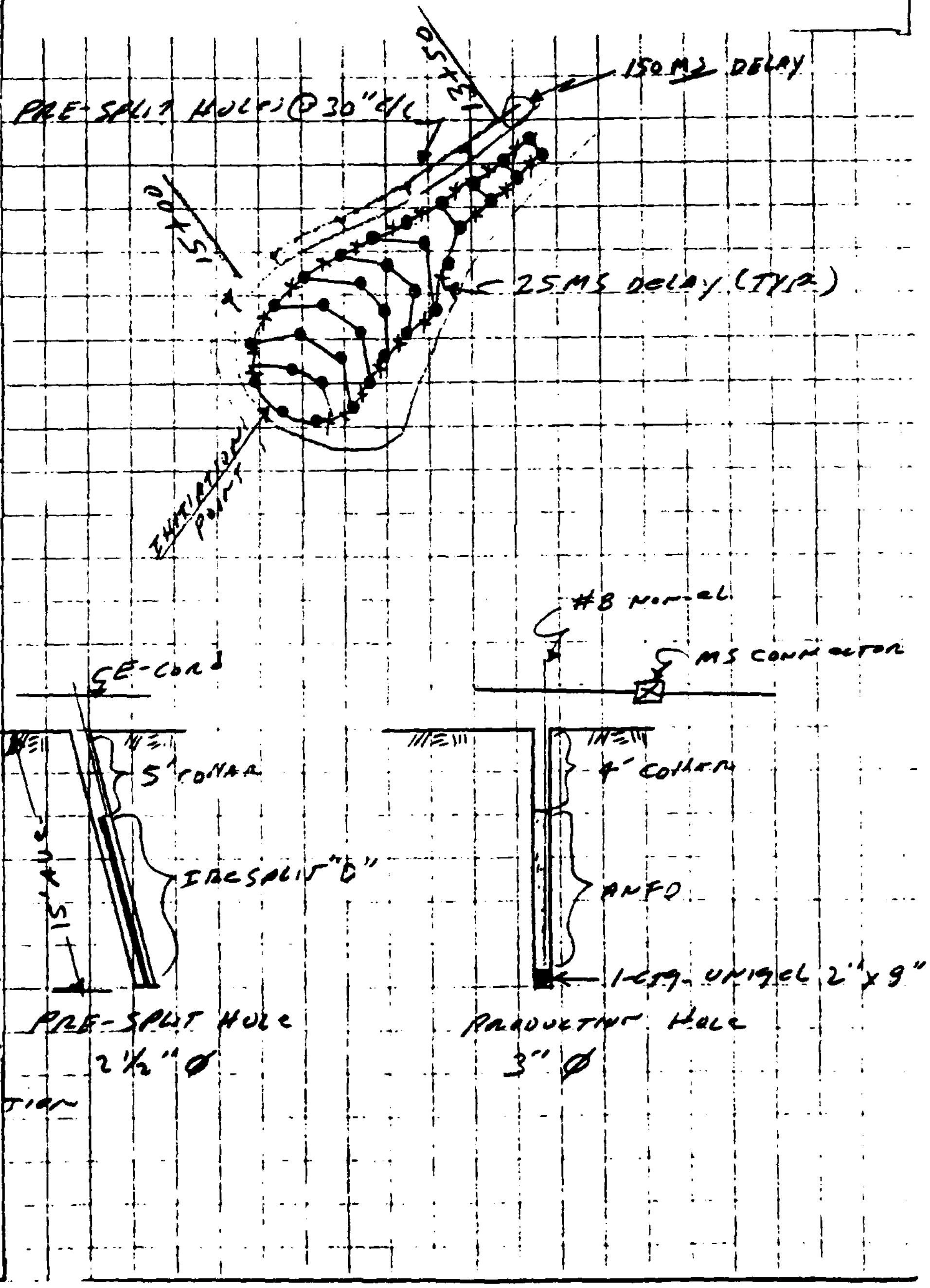
HOLES	SIZE	DEPTH
75	3"	9' AVE
~~25~~ 20	2½"	15' AVE

CAPS	LENGTH	EACH
#8	12'	76

MAX. POUNDS/DELAY
100

REMARKS, DAMAGE FLYROCK, EVALUATION
Good FRAGMENTATION
MIN. FLYROCK

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

PROJECT

* AS BUILT

SHOT NO. 14

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47-C-89-0036	McCAWS	2+43.7 TO 3+75	SPILLWAY-RT-SIDE D/S OF DAM
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
LIMESTONE	925 LB.	~~1129 CY.~~ 962 CY. 292 SY.	See Notes Below
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
11:00AM	2:45PM	JAN 24-90 3:30PM	K. Joi

WIND AND WEATHER
Sunny - N 15 mph

WATER IN HOLES
Nil

STEMMING
Drill cuttings

POWDER TYPE	LBS.
IRESPLIT D	175 ~~150~~ Lb.
UNIMAX 2"x8"	50 Lb
ANFO	~~1000~~ 700 Lb

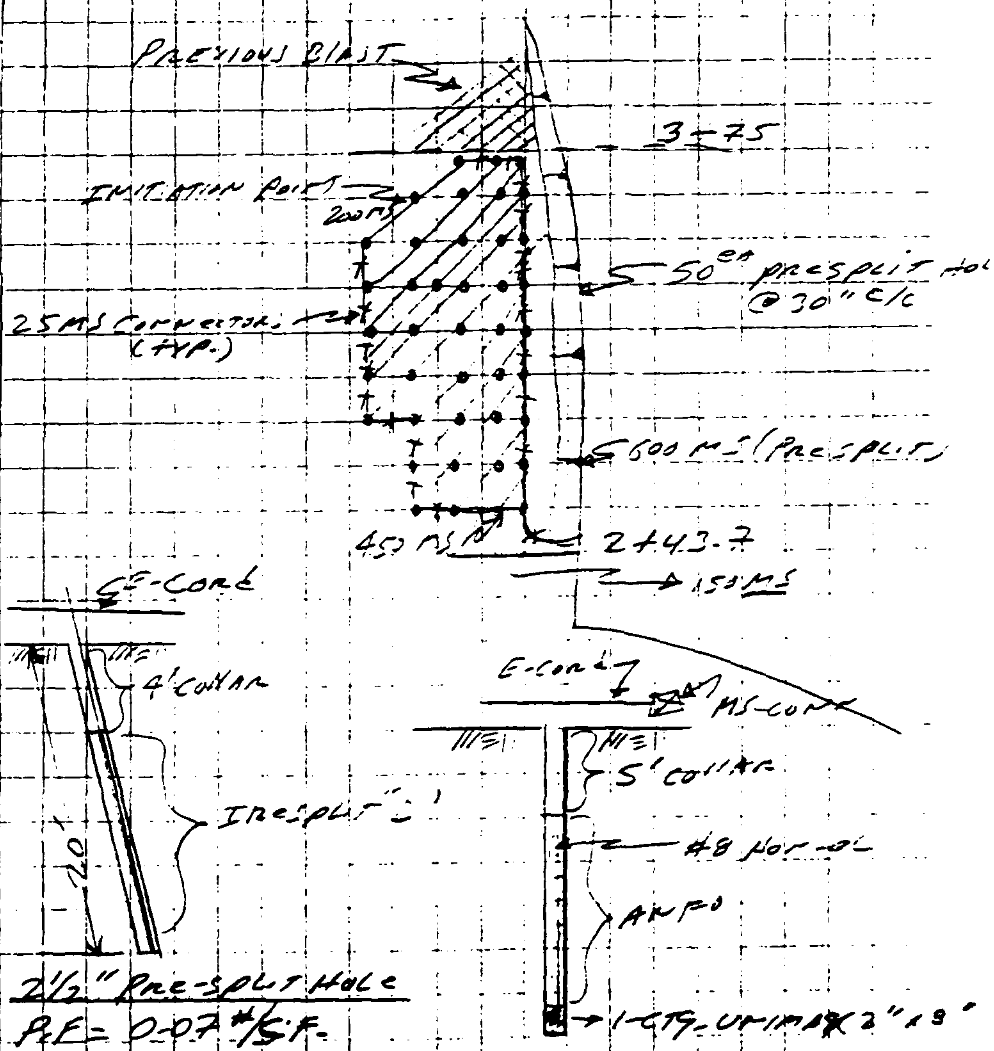
HOLES	SIZE	DEPTH
50	2½"	20'
40	3"	10' AVE.

CAPS	LENGTH	EACH
#8	20'	41

MAX. POUNDS/DELAY
180 Lb.

REMARKS, DAMAGE FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



2½" PRE-SPLIT HOLE
P.F. = 0.07 #/S.F.

3" Ø PRODUCTION HOLE
P.F. = ~~0.95~~ 0.78 Lb/CY

* REF. BLASTING PLAN #90-02

BLASTING REPORT

G-100

PROJECT

SHOT NO. 18

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47C-89-C056	McCAW	4+26 Line To 4+84 "C"	RT. Abutment Keyway
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
Limestone	~~2150~~ 1400	~~1790~~ 1063	~~1.20~~ 1.32
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
2:00PM	5:00PM	JAN-30-90 5:30PM	

WIND AND WEATHER: Sunny-Calm

WATER IN HOLES: Nil

STEMMING: Drill Cuttings

POWDER TYPE	LBS.
Unimax 2"x9"	~~150~~ 125 Lbs
ANFO	~~200~~ 1275 Lbs

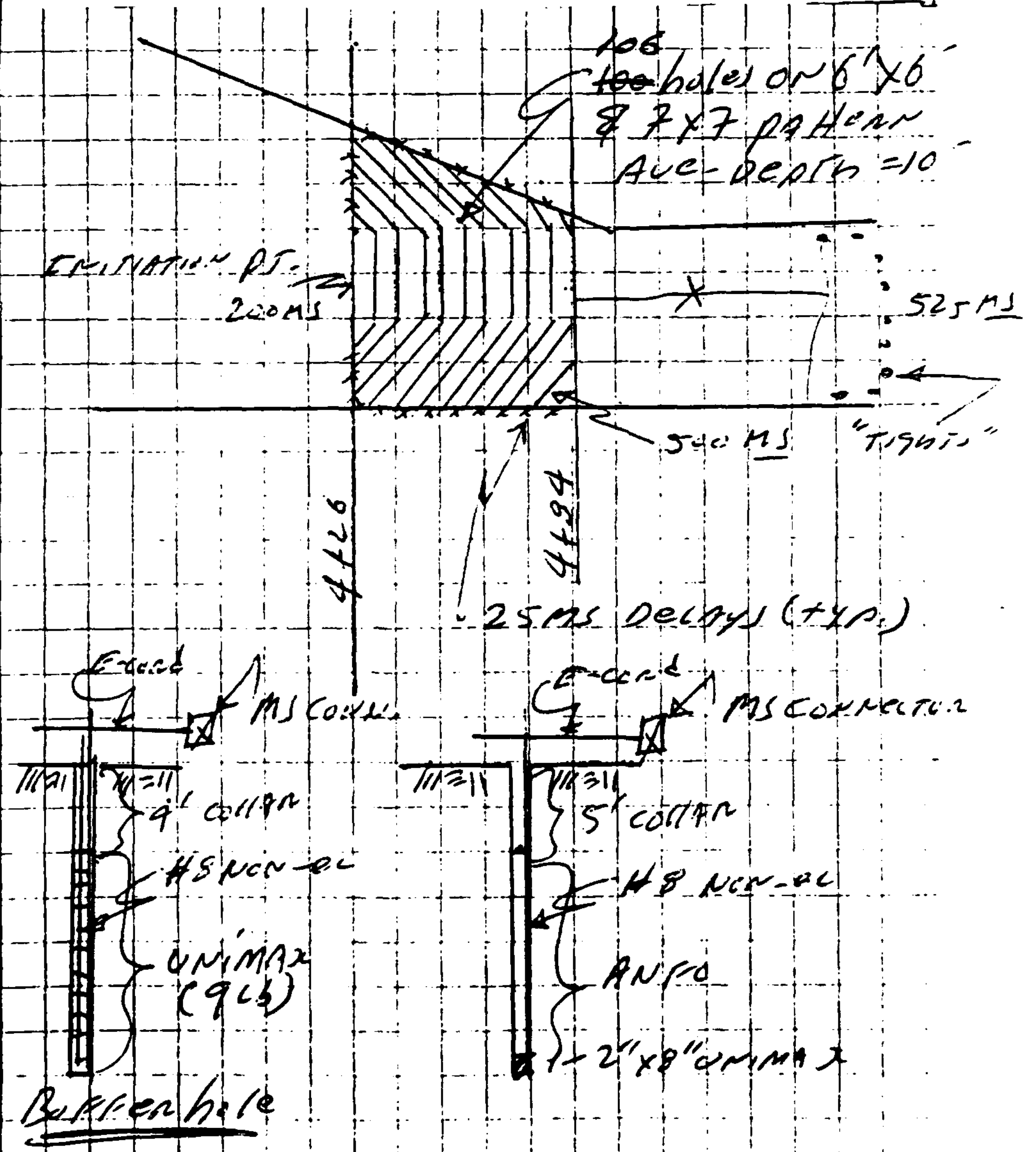
HOLES	SIZE	DEPTH
~~100~~ 106	3"	10' Ave

CAPS	LENGTH	EACH
#8	20'	107

MAX. POUNDS/DELAY: 150 Lbs

REMARKS, DAMAGE FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

G-101

PROJECT

* AS BUILT

SHOT NO. #23

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-[illegible]	McCann	3475 to 4226	RT. Abutment [illegible]
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
Lime stone	2200 lb	1700 CY	1.29 lb/cy
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
1:00 pm	5:00 pm	FEB 6-90 5:35 pm	[illegible]

WIND AND WEATHER: Sunny - Calm

WATER IN HOLES: N/A

STEMMING: [illegible]

POWDER TYPE	LBS.
UNIMAX 2"x9"	150
ANFO	1600

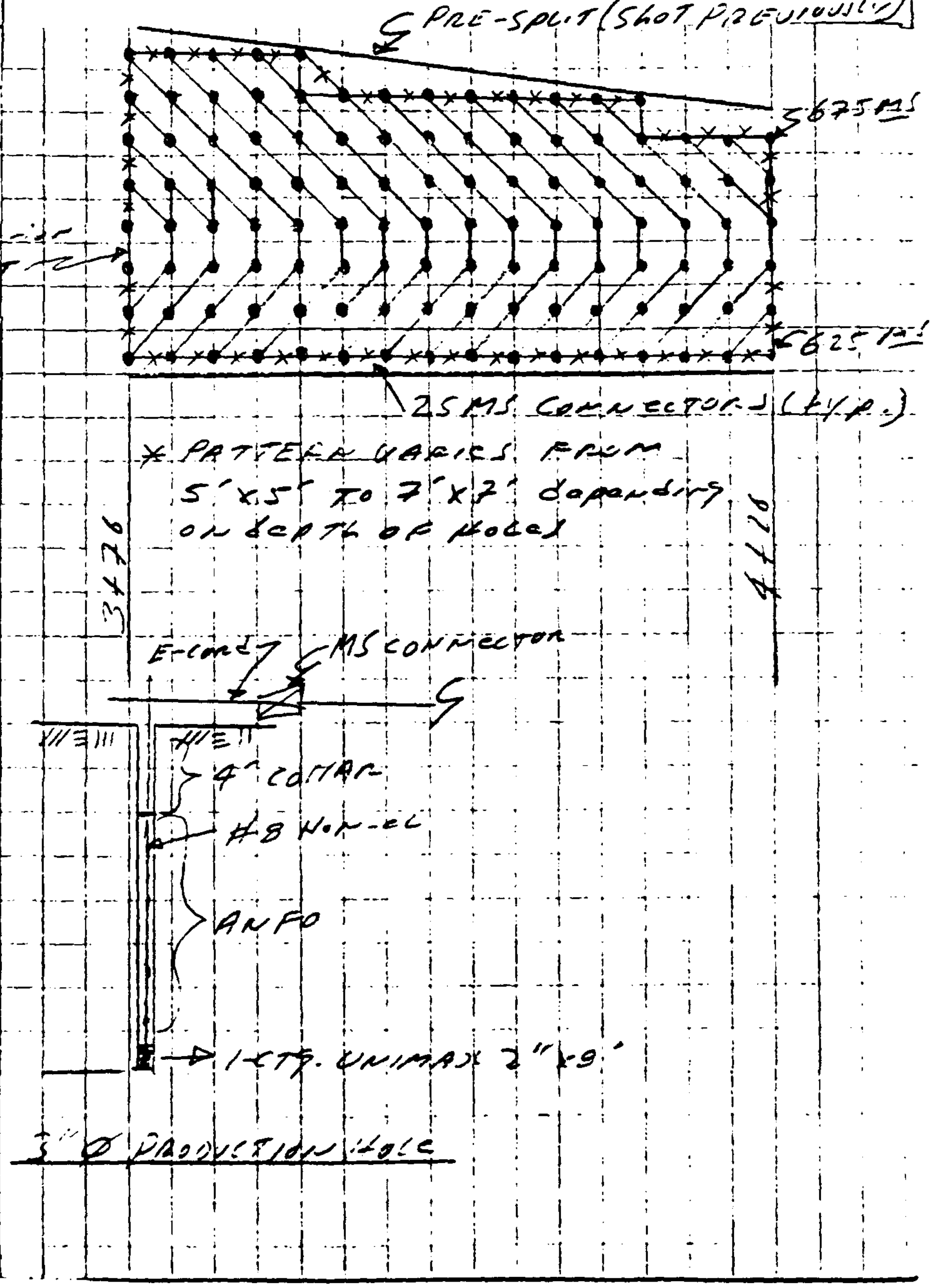
HOLES	SIZE	DEPTH
120	3"	12' AVG

CAPS	LENGTH	EACH
#8	20'	60
#8	12'	60

MAX. POUNDS/DELAY: 120

REMARKS, DAMAGE FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

G-102

PROJECT * AJ BOT-J

SHOT NO. 27

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-47-C-89-0055	McCANS	2+40 TO 3+50 (+/-)	UPPER LEVEL OUTLET WORKS
ROCK TYPE: LAYERED SHALE & LIMESTONE	TOTAL POWDER LBS.: 775 Lb.	ROCK IN-PLACE C.Y.: 160 SY 930 CY	POWDER FACTOR: 0.16 Lb/L.F. (PRE-SPLIT) 0.05 Lb/S.F. (PRE-SPLIT) 0.75 Lb/CY (PRODUCTION)
LOADING START: 8:00 AM	LOADING FINISH: 12:00 NOON	TIME AND DATE FIRED: FEB 12-90 12:30 PM	SIGNATURE: K. Lo[illegible]

WIND AND WEATHER: SUNNY-CALM

WATER IN HOLES: NIL

STEMMING: DRILL CUTTINGS

POWDER TYPE	LBS.
PRESPLIT "D"	75
UNIGEL	50 Lb.
2"x8"	650 Lb
ANFO	

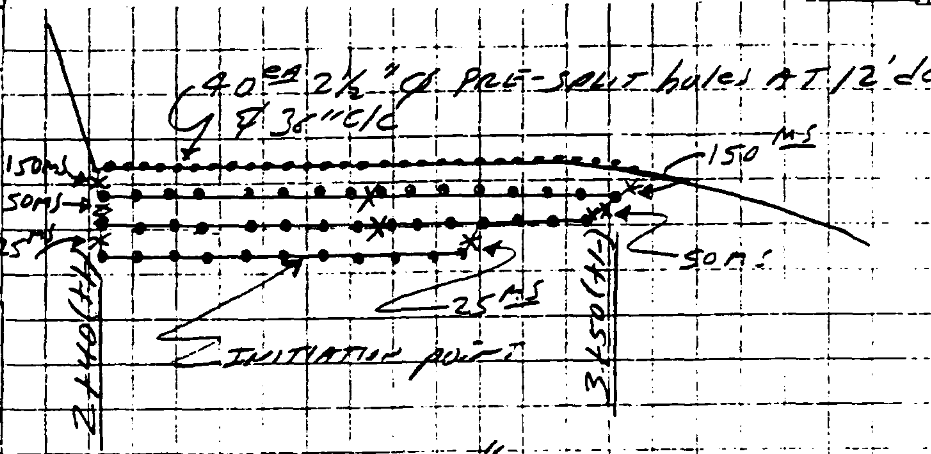
HOLES	SIZE	DEPTH
40	2½"	12'
42	3"	8' AVE

CAPS	LENGTH	EACH
#8	12'	4

MAX. POUNDS/DELAY: 200 Lb.

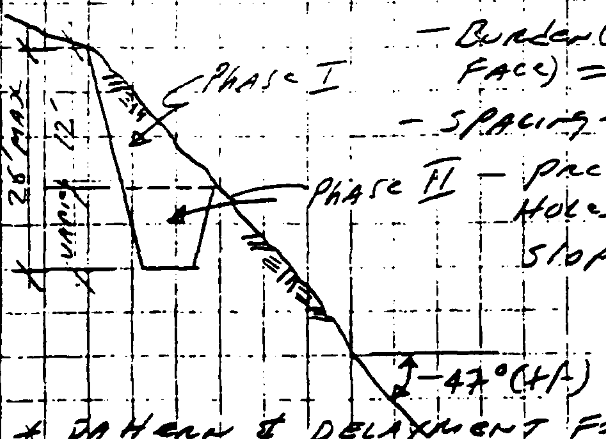
REMARKS, DAMAGE FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



* INITIATION SHALL BE "ROW BY ROW" because OF SIDEHILL SECTION (47° SLOPE)

* THIS PROPOSAL IS FOR CUSHION BLASTING & IS PHASE (I) OF A PROPOSED TWO PHASE APPROACH TO THE UPPER LEVEL OUTLET WORKS BLASTING (SEE SECT. BELOW)



— BURDEN (IN DIRECTION OF FREE FACE) = 6'-0"

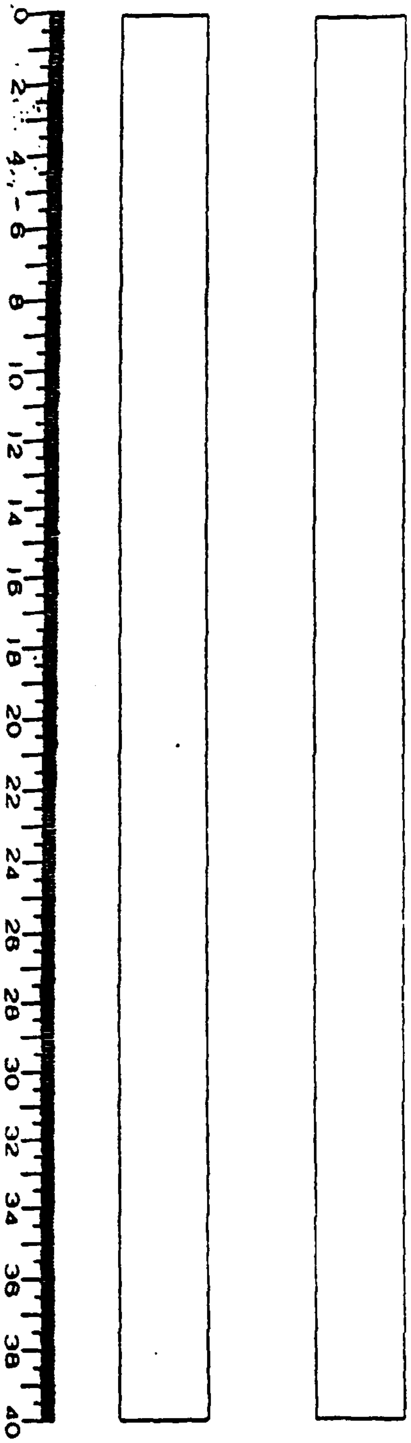
— SPACING = 7'-0"

PHASE II — PRESPLIT & PRODUCTION HOLES DRILLED @ .25 TO 1 SLOPE

* PATTERN & DELAYMENT FOR PHASE II TO be determined AFTER PHASE I EXCAVATION IS COMPLETED.

BLASTING REPORT

TYPICAL LOADED HOLE



PRESPLIT

PRODUCTION OR OTHER

- EVERY 2nd PRE-SPLIT HOLE SHALL BE LOADED WITH A CONTINUOUS COLUMN LOAD OF IRESPLIT "D" TO A 4.0' COLLAR
- ALTERNATING PRE-SPLIT HOLES SHALL BE LOADED WITH TWO CARTRIDGES OF IRESPLIT "D" AS A TOE LOAD (1-2 1/4 LBS)
- PRODUCTION HOLES SHALL BE PRIMED WITH A 2" x 8" CARTRIDGE OF UNIGEL & A COLUMN LOAD OF ANFO TO A 6.0' COLLAR

BURDEN ______

SPACING ______ ______

PROJECT

SHOT NO. 27

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-47-89-C-0055	McCAW	2+47 TO 3+07	High Level Outlet Works
ROCK TYPE: Layered Shale & Lime stone	TOTAL POWDER LBS.: 289 Lb	ROCK IN-PLACE C.Y.: 209 SY. 600 CY.	POWDER FACTOR: 0.05Lb/SF - 0.16 Lb/L-F. 0-48Lb/cy
LOADING START: 1:00 PM	LOADING FINISH: 3:00 PM	TIME AND DATE FIRED: Feb 19-90 3:30 PM	SIGNATURE: Kilo

WIND AND WEATHER: 10 MPS-South/Clear

WATER IN HOLES: Nil

STEMMING: Drill cuttings

POWDER TYPE	LBS.
Unimax 1½×8"	92 Lb
Unigel 2"×8"	150 Lb
Irespli "D"	94 Lb

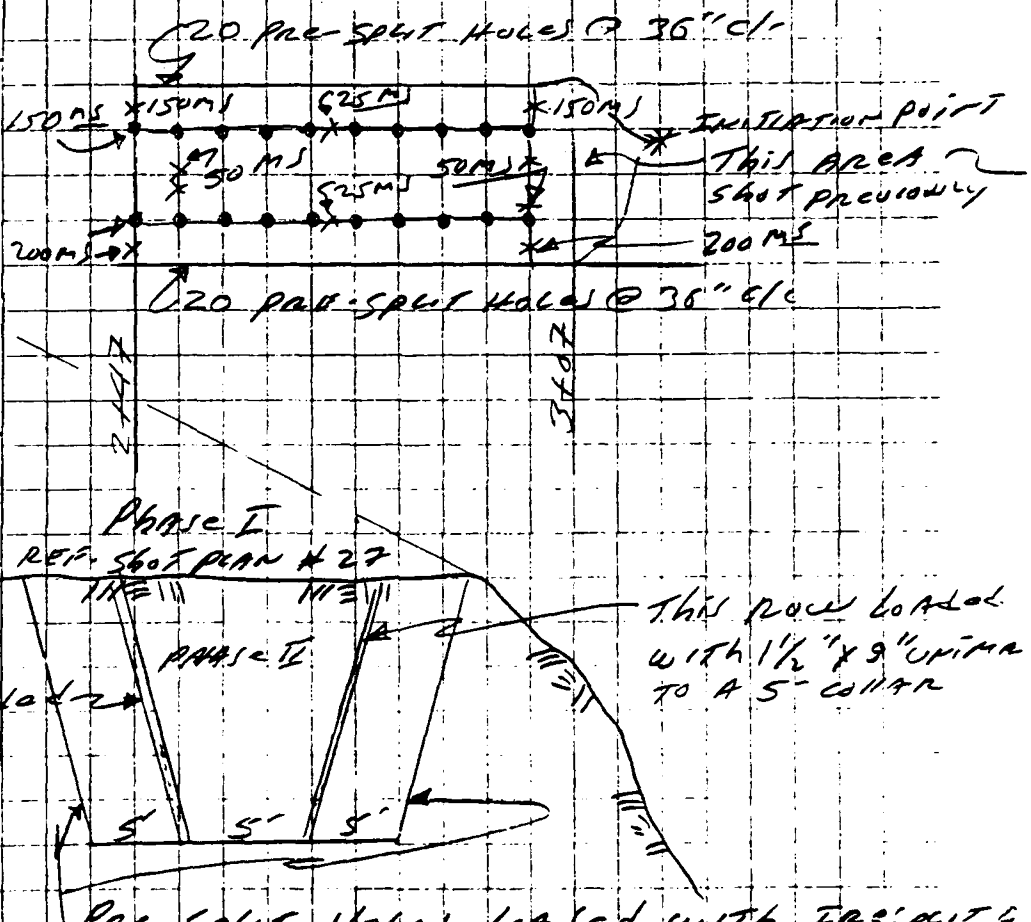
HOLES	SIZE	DEPTH
20'	3"	15'
40	2½"	15'

CAPS	LENGTH	EACH
#8	20'	22

MAX. POUNDS/DELAY: 47 Lb.

REMARKS, DAMAGE FLYROCK, EVALUATION: Broke big min. fly wall looks O.K.

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



Pre split holes loaded with Irespli to a 6' collar. Every 2nd hole loaded with 3 cartridges of Irespli as a toe load only

BLASTING REPORT

PROJECT

SHOT NO. 38

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
[illegible]	[illegible]	[illegible]	[illegible]

ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
Limestone / [illegible] / Shale	Presplit - 148.4 LBS Production : 709.- LBS	Presplit [illegible] Production . 1206.[illegible]	[illegible] Production - [illegible]

LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
7 30 Am	10 30 Am	1150 Am 3/12/90	[illegible]

WIND AND WEATHER

Calm / clear

WATER IN HOLES

No

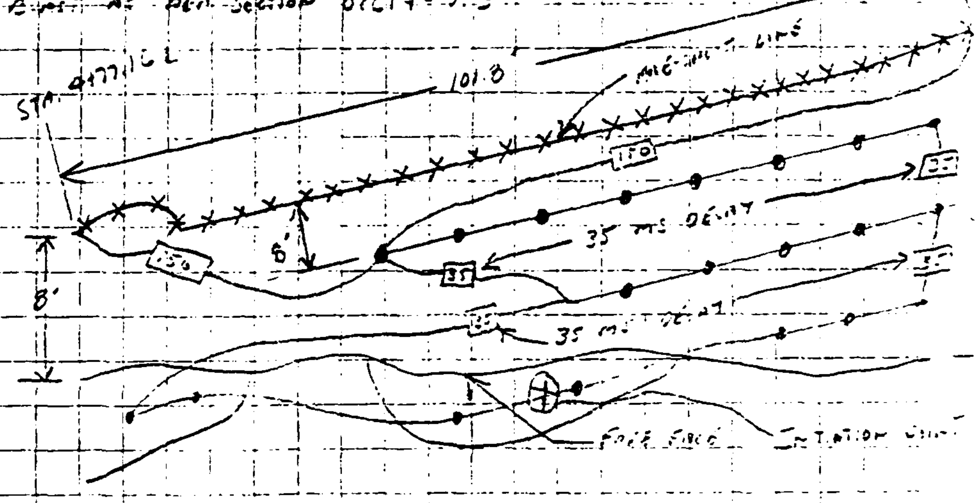
STEMMING

Drill cuttings

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

Due to the small amount of burden in front of the presplit line, the contractor choose to use a cushion blast as per section 02219-7.3

POWDER TYPE	LBS.
Ire-split D 7/8 x 24	148.4
Unigel 2 x 8"	23.0
Anfo	686.4
Avg lbs/hole	35.5



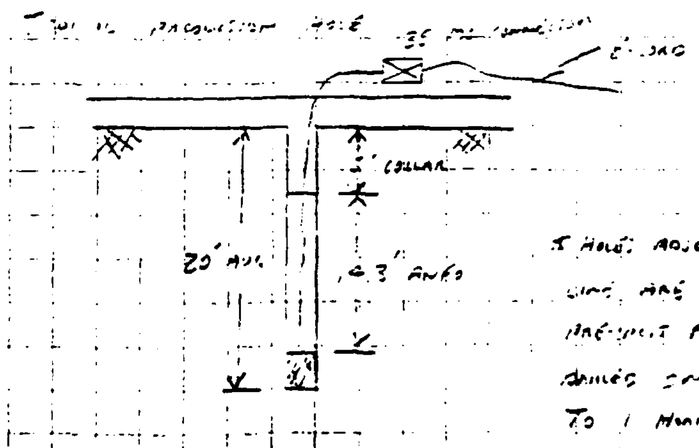
	HOLES	SIZE	DEPTH
Presplit	30	2 1/2	25' Ave
Production	20	3"	20' Ave

Drill pattern : 6' x 8'

	CAPS	LENGTH	EACH
Trace	#8	20'	20
Surface	35 ms	—	4
	150 ms	—	2

* Presplit holes drilled on 30" centers. Loaded with 10 sticks average per hole [illegible] with a wad of paper [illegible]

Typical production hole



* Holes adjacent to presplit line are 3 ft from presplit face and are drilled [illegible] to 1 horizontal slope

MAX. POUNDS/DELAY

8 Holes = 233.6 LBS

REMARKS, DAMAGE FLYROCK, EVALUATION

Shot went Good

BLASTING REPORT

PROJECT

SHOT NO. 42.

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-47-C-89-0056	McCAWS	4477/6462	PRODUCTION
ROCK TYPE: Layered Shale & Limestone	TOTAL POWDER LBS.: 1150 ~~1546 lb~~	ROCK IN-PLACE C.Y.: 1237 CY	POWDER FACTOR: ~~1.25~~ 0.93
LOADING START: 10:00 AM	LOADING FINISH: 3:00 PM	TIME AND DATE FIRED: MAR 20/90 3:45 PM	SIGNATURE: K. [illegible]

WIND AND WEATHER: CALM/SUNNY

WATER IN HOLES: NIL

STEMMING: DRILL CUTTINGS

POWDER TYPE	LBS.
UNIMAX 2"x8"	150 lb ~~200~~
ANFO	1000 ~~1346~~ lb

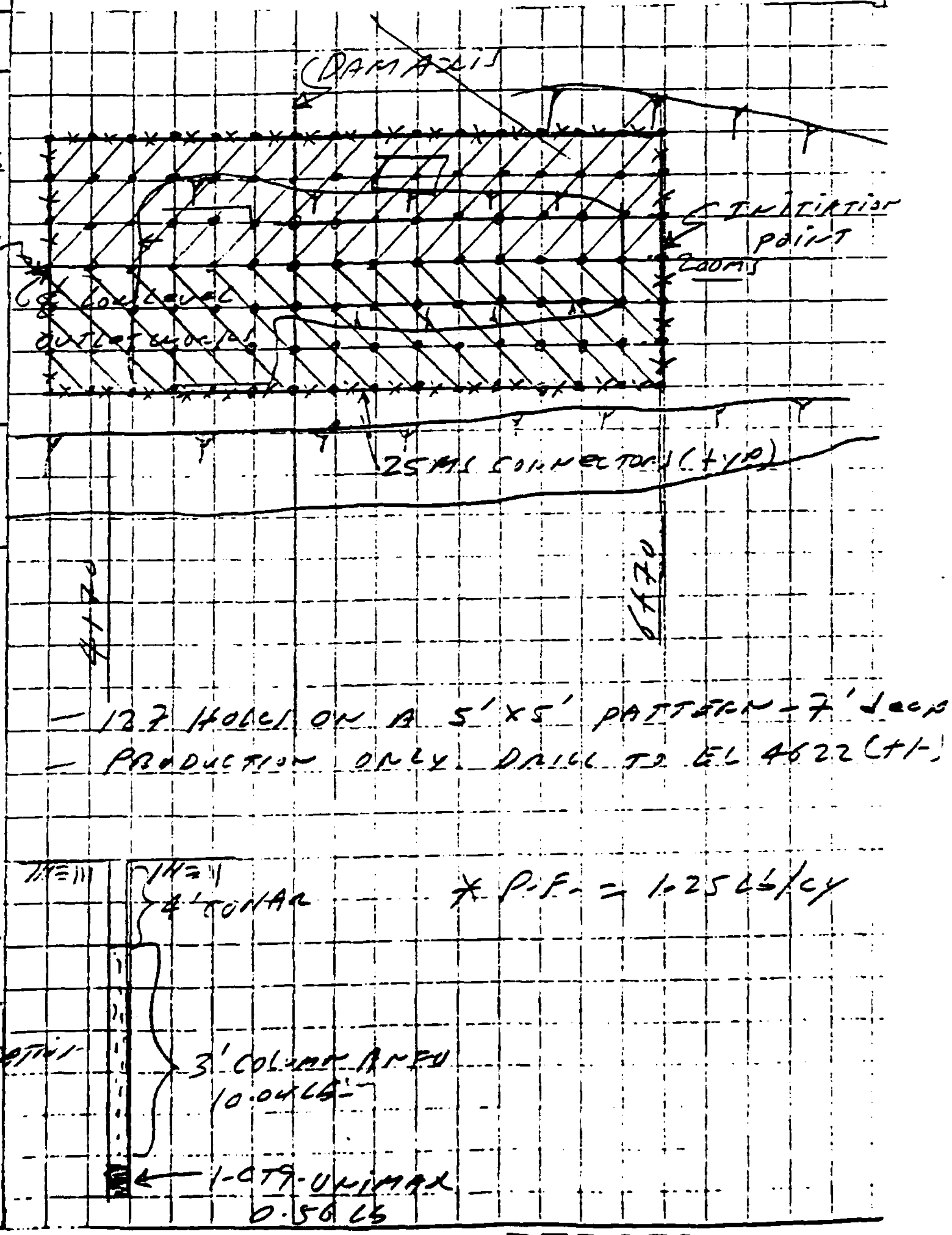
HOLES	SIZE	DEPTH
127	3"	7'

CAPS	LENGTH	EACH
#8	12'	128

MAX. POUNDS/DELAY: 74.2 lb.

REMARKS, DAMAGE FLYROCK, EVALUATION: Good Fragmentation min. fly.

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

SHOT PLAN

PROJECT * AS BUILT

SHOT NO. 45

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47-89-C-0056	McCAWS	3+00 - 5+00 LT-SIDE LINE 5	AUXILIARY SPILLWAY
ROCK TYPE Conglomerate (HARD)	**TOTAL POWDER LBS.** ~~3450~~ 3650	**ROCK IN-PLACE C.Y.** 5357 CY ~~5173~~	**POWDER FACTOR** ~~0.67~~ 0.68
LOADING START 10:00AM	**LOADING FINISH** 5:15PM	**TIME AND DATE FIRED** MARCH 29/90 5:40PM	**SIGNATURE** K. J.

WIND AND WEATHER: COOL-CLEAR

WATER IN HOLES: NIL

STEMMING: DRILL CUTTINGS

POWDER TYPE	LBS.
UNIMAX 1½" X 8"	~~250~~ 300
ANFO	~~3200~~ 3350

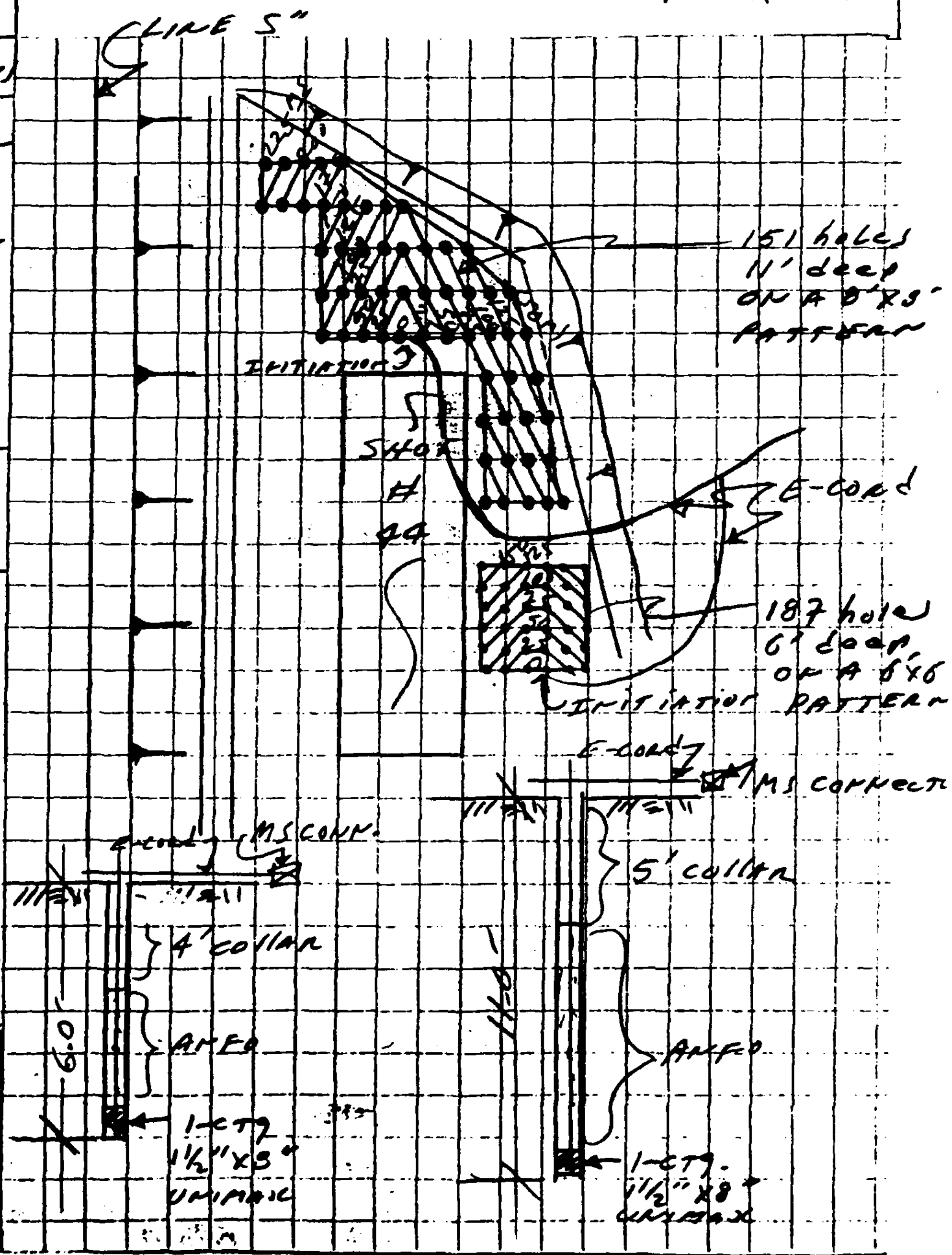
HOLES	SIZE	DEPTH
338	3"	8' AVE

CAPS	LENGTH	EACH
#8	12'	2

MAX. POUNDS/DELAY: 120

REMARKS, DAMAGE FLYROCK, EVALUATION: Good Swell FACTOR. MINIMUM FLY.

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

Apr.l /12/91 (?)

PROJECT

SHOT NO. 51

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47-C-89-0056	McCaw's Drilling	2720 S Auxilary Spillway	Production
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
Hard conglomerate rock	47.21 LBS	60 CY	0.79 LBS/CY
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
7:30 Am	8:30 Am	April 13/91 8:40 Am	[illegible]

WIND AND WEATHER	
WATER IN HOLES	None
STEMMING	Drill cuttings

POWDER TYPE	LBS.
UNIGEL 2×8"	47.21
Avg LBS/Hole	1.15 LBS/Hole

HOLES	SIZE	DEPTH
41	3"	4.0' Avg

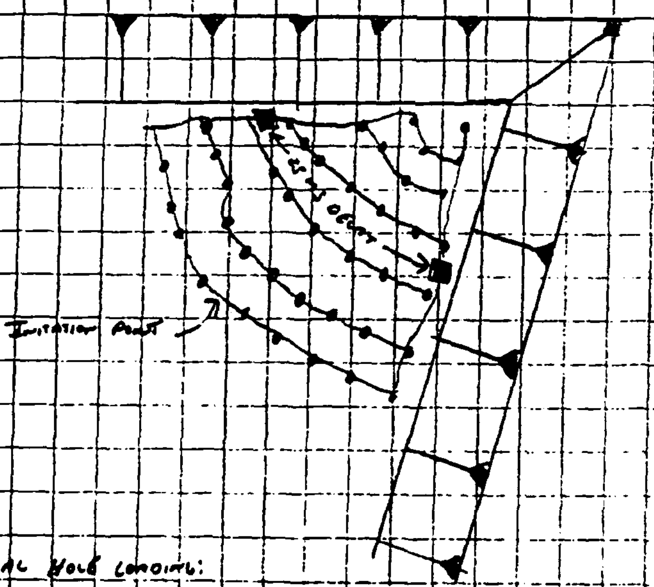
CAPS	LENGTH	EACH
25ms	—	2

MAX. POUNDS/DELAY
23.6 LBS

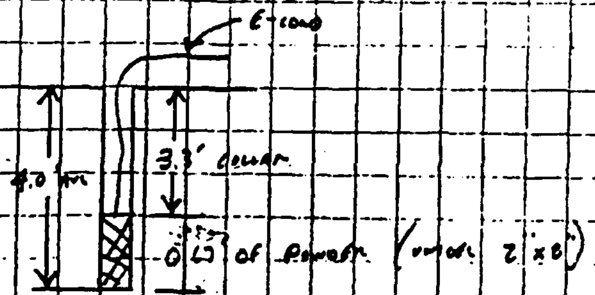
REMARKS, DAMAGE, FLYROCK, EVALUATION
Little FLYRock

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

* Blast Tights at Auxilary Spillway
41 Random Holes



Typical Hole Loading:



BLASTING REPORT

PROJECT

Apr. 1 14/90 TS Blast

SHOT NO. 52

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW 47-95-C-0056	MCCAWS	2+90 / 4+10	PRESPLIT & PRODUCTION
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
Layered Shale & Limestone	1513 LB.	556 SY. 1185 CY	0.98 LB/CY 0.28 LB. SF 0.25 LB. FOOT
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
9:50 AM	2:30 AM.	2:45 Pm April 16/90	[illegible]

WIND AND WEATHER: Sunny

WATER IN HOLES: Nil

STEMMING: Drill cuttings

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

POWDER TYPE	LBS.
Unigel 2"x8"	33 LB.
ANFO	1130 LB.
Presplit D	350 LB.

HOLES	SIZE	DEPTH
60	2½"	30' (Avg)
30	3"	20'

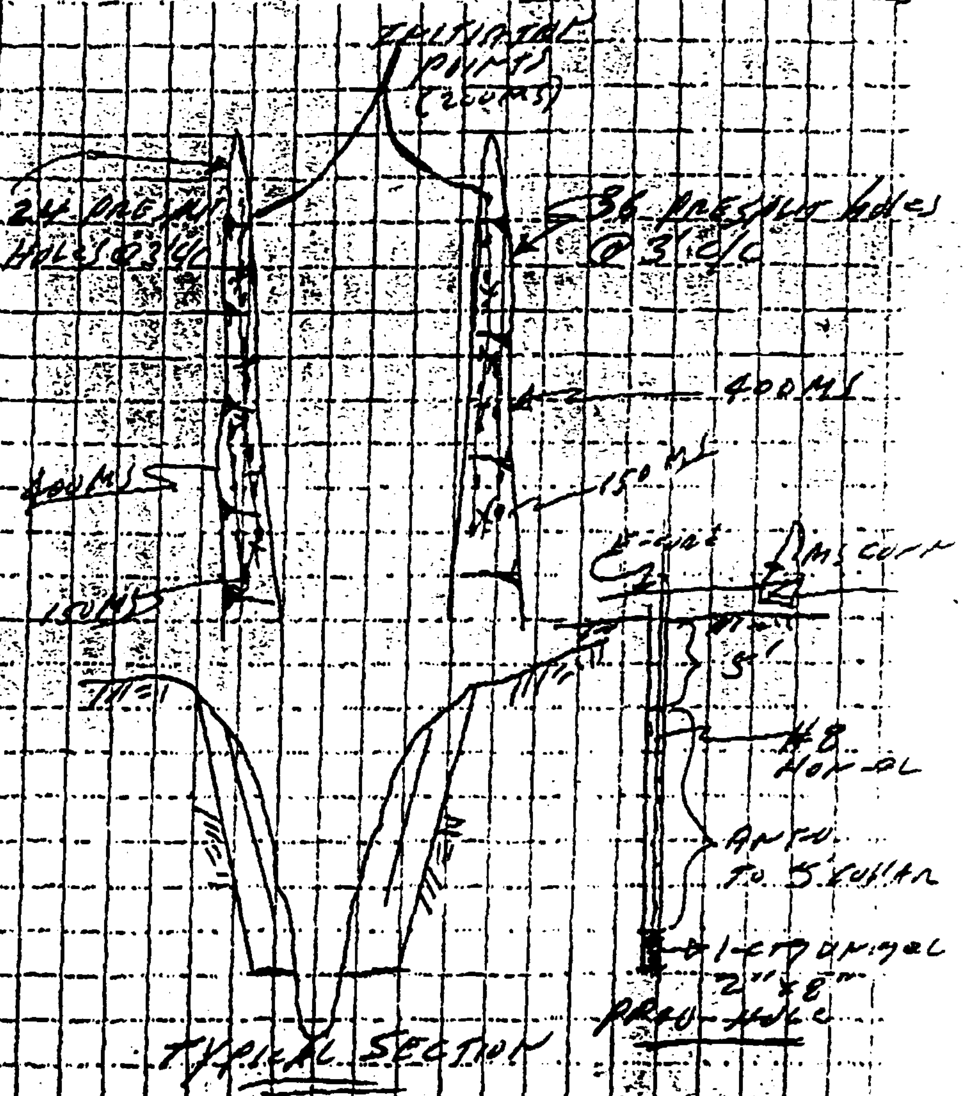
CAPS	LENGTH	EACH
#8	20'	30

MAX. POUNDS/DELAY: 40.4

REMARKS, DAMAGE FLYROCK, EVALUATION:

Little Flyrock

Good Breakage



* Pre-split holes loaded with a continuous column load of "Presplit D" to a 5' collar.

BLASTING REPORT

G-110

X AS BUILT

PROJECT

May 4/90

SHOT NO. 57

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-67-C-89-0056	McCAWS	1437-2425 LINE "O"	PRE-SPLIT & PRODUCTION Lt. Side
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
LAYered Shale & Limestone	764	313 SY. 782 CY	0.87Lb SF/0.20 Lb/LF 0.73Lb/CY
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
8:00AM	12:00 Noon	MAY 7-90 12:30 PM	[signature]

WIND AND WEATHER: SUNNY

WATER IN HOLES: Nil

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

STEMMING: Drill Cuttings

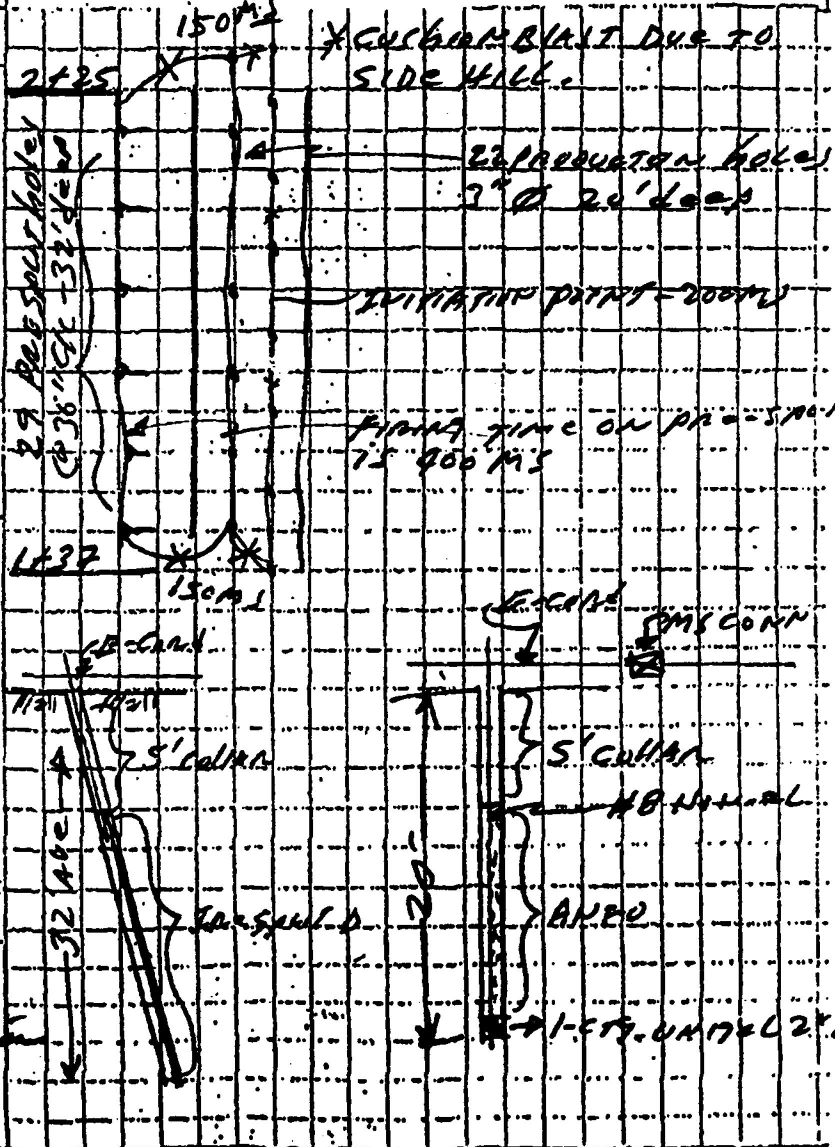
POWDER TYPE	LBS.
IREsplit D	190
Unimel 2"x8"	24
ANFO	550

HOLES	SIZE	DEPTH
29	2½"	32'
22	3"	20'

CAPS	LENGTH	EACH
#8	20'	22

MAX. POUNDS/DELAY: 190Lb-PRESPLIT

REMARKS, DAMAGE FLYROCK, EVALUATION: Good FRAGMENTATION



BLASTING REPORT

PROJECT * AS BUILT

SHOT NO. 58

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47-89C-0056	McCAWS	1400-2725 Line D	Pre-split Secondary Blasting
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
Layered Shale & Limestone	365 Lb	408 SY ~~37cy~~ 694cy	0.25 Lb/L.F./.08 Lb/SF 1.65 Lb cy. Boulder
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
4:30 PM	6:30 PM	May 10-90 7:00 PM	[signature]

WIND AND WEATHER: O/CAST

WATER IN HOLES: N/C

STEMMING: Drill cuttings

POWDER TYPE	LBS.
Iresplit D	304
Unigel 2"x8"	61 Lb

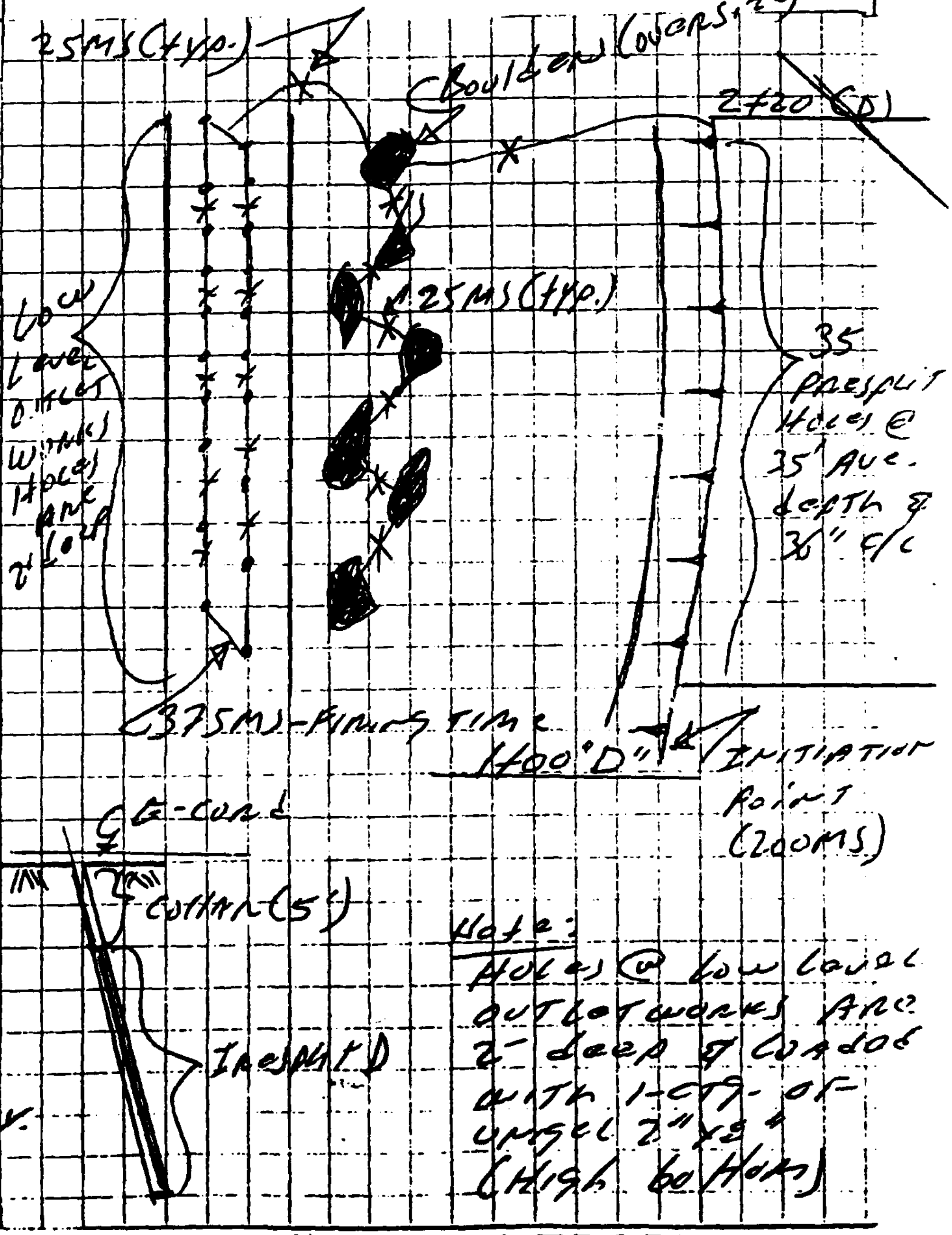
HOLES	SIZE	DEPTH
~~2½"~~ 35	2½"	35'
20	2½"	2'

CAPS	LENGTH	EACH
#8	12'	1

MAX. POUNDS/DELAY: 304 Lbs - Presplit

REMARKS, DAMAGE FLYROCK, EVALUATION: Good breakage wall looks O.K. Estimated 694 cy. broken with Pre-split holes

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



Note: Holes @ low level outlet works are 2' deep & loaded with 1-Stk. of Unigel 2"x8" (High bottom)

* LAST PRODUCTION BLAST. BLASTING REPORT

HBS ...

PROJECT

June 11 /90

SHOT NO. 65

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-47-89C-0056	McCAWS	3450-4425 4475 LINE "D"	PRODUCTION
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
Limestone	100LS	160	0.63LS/cy
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
5:00	7:00	~~June 11-90~~ 7:30 PM June 11/90	[signature]

WIND AND WEATHER
SUNNY

WATER IN HOLES
N/A

STEMMING
Drill Cuttings

POWDER TYPE	LBS.
unigel 2"x8"	100LS
unigel	150LS
AFFO	5700LS

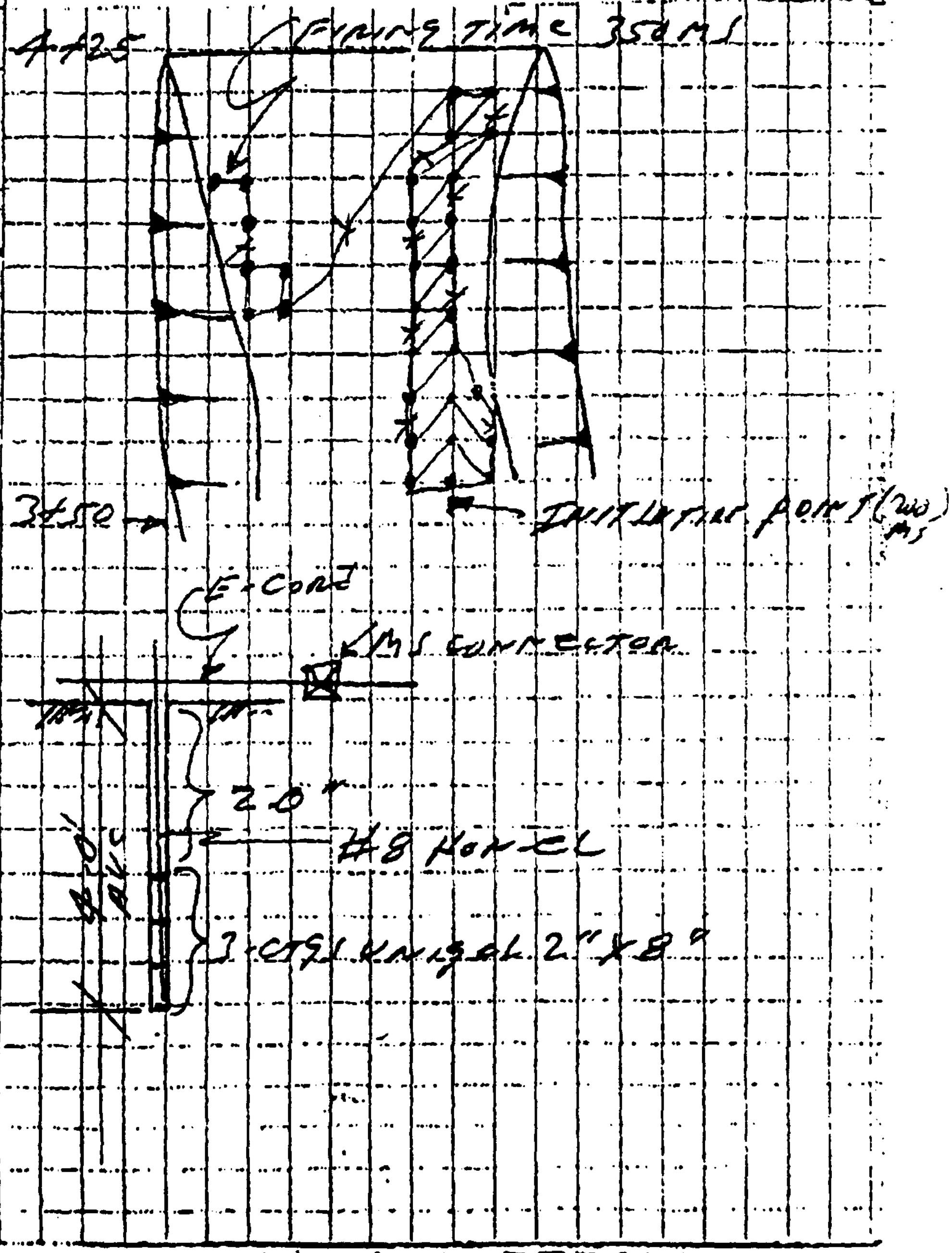
HOLES	SIZE	DEPTH
30	3"	4' AVE

CAPS	LENGTH	EACH
31	12'	#8
61	12	#8

MAX. POUNDS/DELAY
20LS -

REMARKS, DAMAGE FLYROCK, EVALUATION
Good ...
No FlyRock ..

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

G-113

PROJECT

AS Built
June 16 '90

SHOT NO. 68

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW-47-89-C-0056	McCAWS	1425-2425 LINED	PRODUCTION
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
Limestone	500	558	0.90
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
2:00	4:00	June 19 '90 4:30	[illegible]

WIND AND WEATHER
Sunny

WATER IN HOLES
N/L

STEMMING
Drill Cuttings

POWDER TYPE	LBS.
Unigel 2"x8"	110
ANFO	390

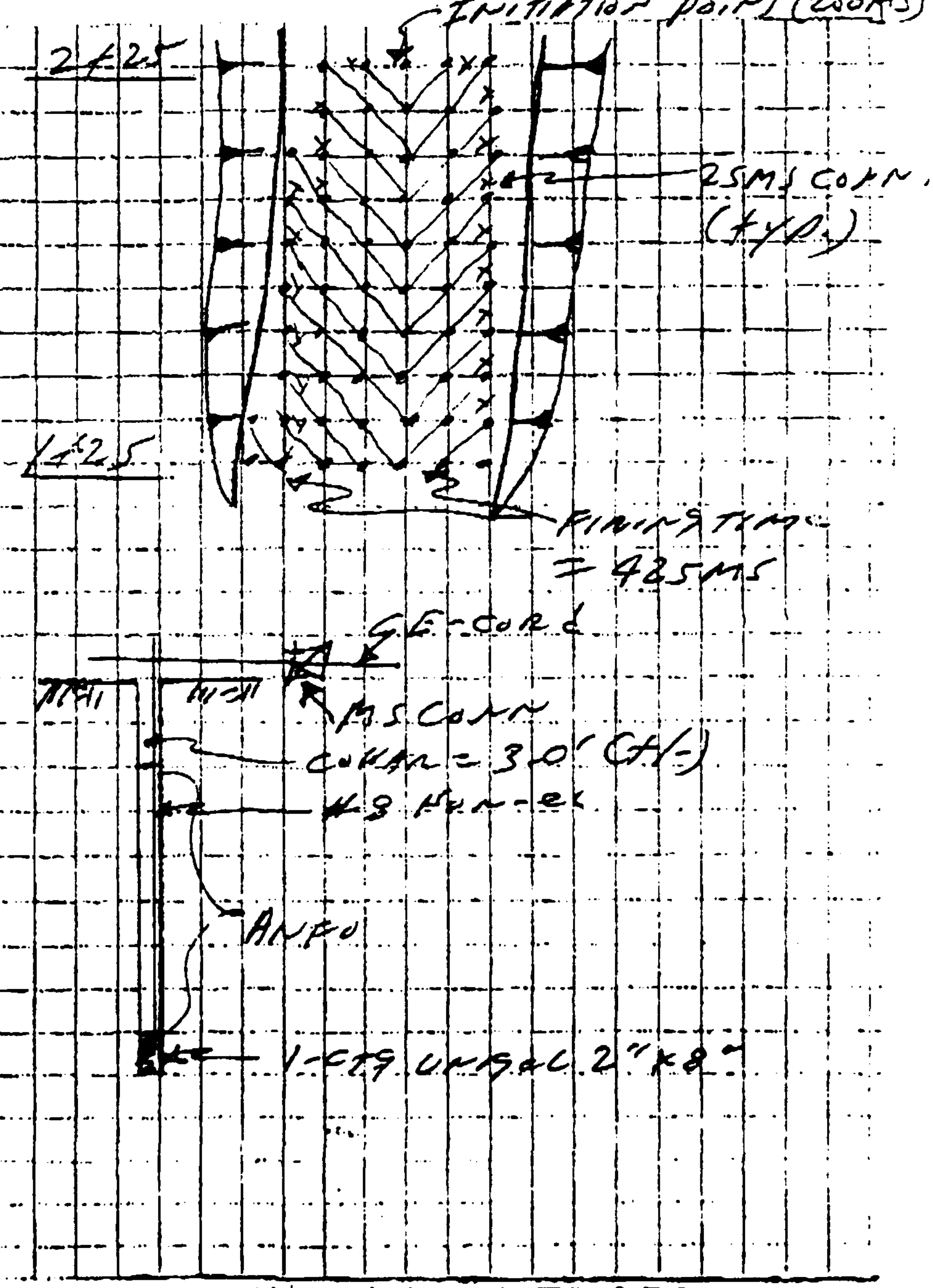
HOLES	SIZE	DEPTH
100	3"	6' Ave

CAPS	LENGTH	EACH
#8	12'	101

MAX. POUNDS/DELAY
30 Lbs.

REMARKS, DAMAGE
FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

PROJECT 12/4/90 SHOT NO. 037-#3

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47-89-C0056	McCaws	3+20 - 3+40	PRE-SPLIT
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
LIMESTONE	20.41	55.6 SY.	0.37 lbs-SY. 0.08 lbs-L.F.
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
8:30 10:15	11:00	2:02 DeC 4/90	[signature]

WIND AND WEATHER: SUNNY

WATER IN HOLES: NIL

STEMMING: DRILL CUTTINGS

POWDER TYPE	LBS.
GELMAX 1½"X16"	14.7
200 grain cord	5.71

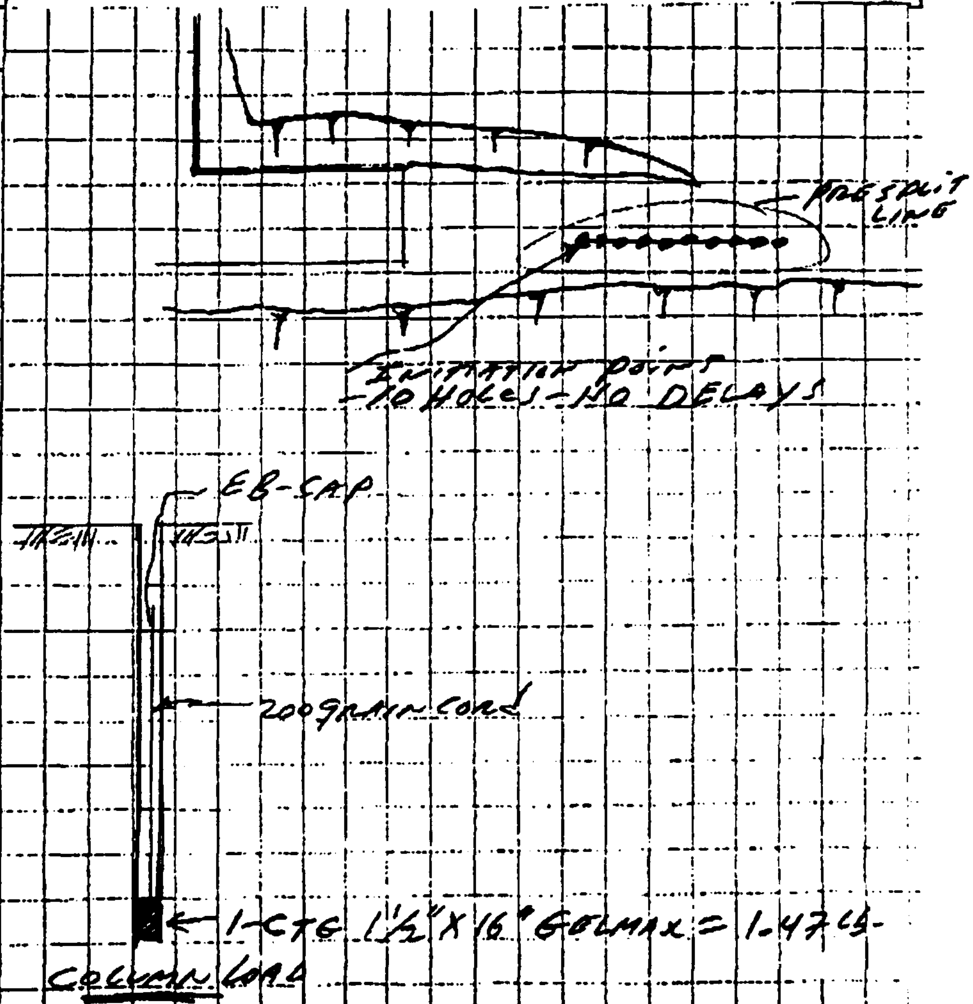
HOLES	SIZE	DEPTH
10	2½"	25'

CAPS	LENGTH	EACH
#1	24'	ONE

MAX. POUNDS/DELAY: 20.41

REMARKS, DAMAGE FLYROCK, EVALUATION: No FLYROCK MATED. ViBeS. OK

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



- SCALED DIST- FACTOR = 14.6
- DIST TO HLOW = 76 FT

BLASTING REPORT

PROJECT 2/6/90

SHOT NO. C37-5

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW4789-C-0056	McCAWS	3+00 3+20	PRESPLIT
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
LIMESTONE	20.41	27.8 SY.	0.08 # S.F. = 0.08 # L.F.
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
10:30	12:00	2:20 PM 12/6/90	[signature]

WIND AND WEATHER: Sunny

WATER IN HOLES: Nil

STEMMING: Drill cuttings

POWDER TYPE	LBS.
1½" x 16" Gelmax	14.7
200 grain cord	5.71

HOLES	SIZE	DEPTH
10	2½"	25'

CAPS	LENGTH	EACH
1	24	1

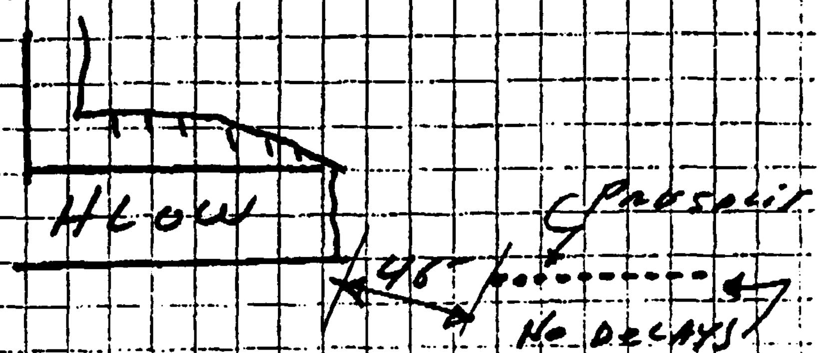
MAX. POUNDS/DELAY: 20.41

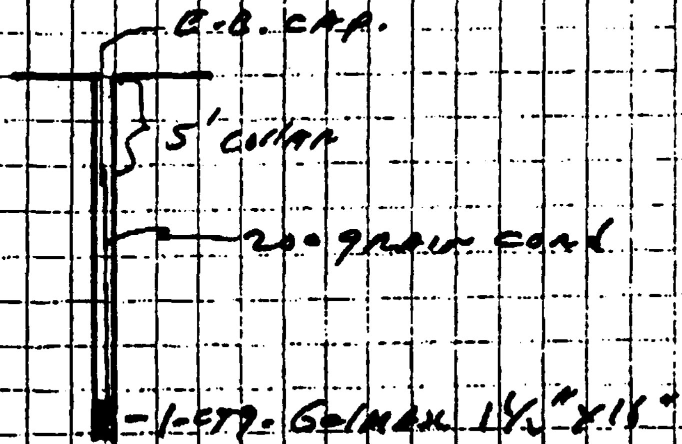
REMARKS, DAMAGE FLYROCK, EVALUATION: mini FlyRock

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

DIST. TO STRUCTURE @ RISK = 46'

SCALED DIST. FACTOR = 10.18





CALC. RESISTANCE:

1 - CAP = 2.3 Ohms

100' wire = .64 Ohms

TOTAL = 2.94 Ohms

BLASTING REPORT

12/11-14 U

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW 47-9?-C-0??	McClaws	2+40/2+80 (+/-)	PRE-SPLIT PRODUCTION
ROCK TYPE	**TOTAL POWDER LBS.**	**ROCK IN-PLACE C.Y.**	**POWDER FACTOR**
LIMESTONE	~~?~~ 80.41	233 CY. 56 SY.	~~0.23 lb/cy~~ 0.0466/SF = 0.05 lb/SF
LOADING START	**LOADING FINISH**	**TIME AND DATE FIRED**	**SIGNATURE**
8:00AM	10:30AM	12-13-90 11:05AM	[signature]

WIND AND WEATHER: High overcast

WATER IN HOLES: N/C

STEMMING: Drill cuttings

POWDER TYPE	LBS.
2" x 16" Gelmax	~~?~~ ~~?~~ 60.0
1½" x 16" Gelmax	14.7
200 grain cord	5.71 LB

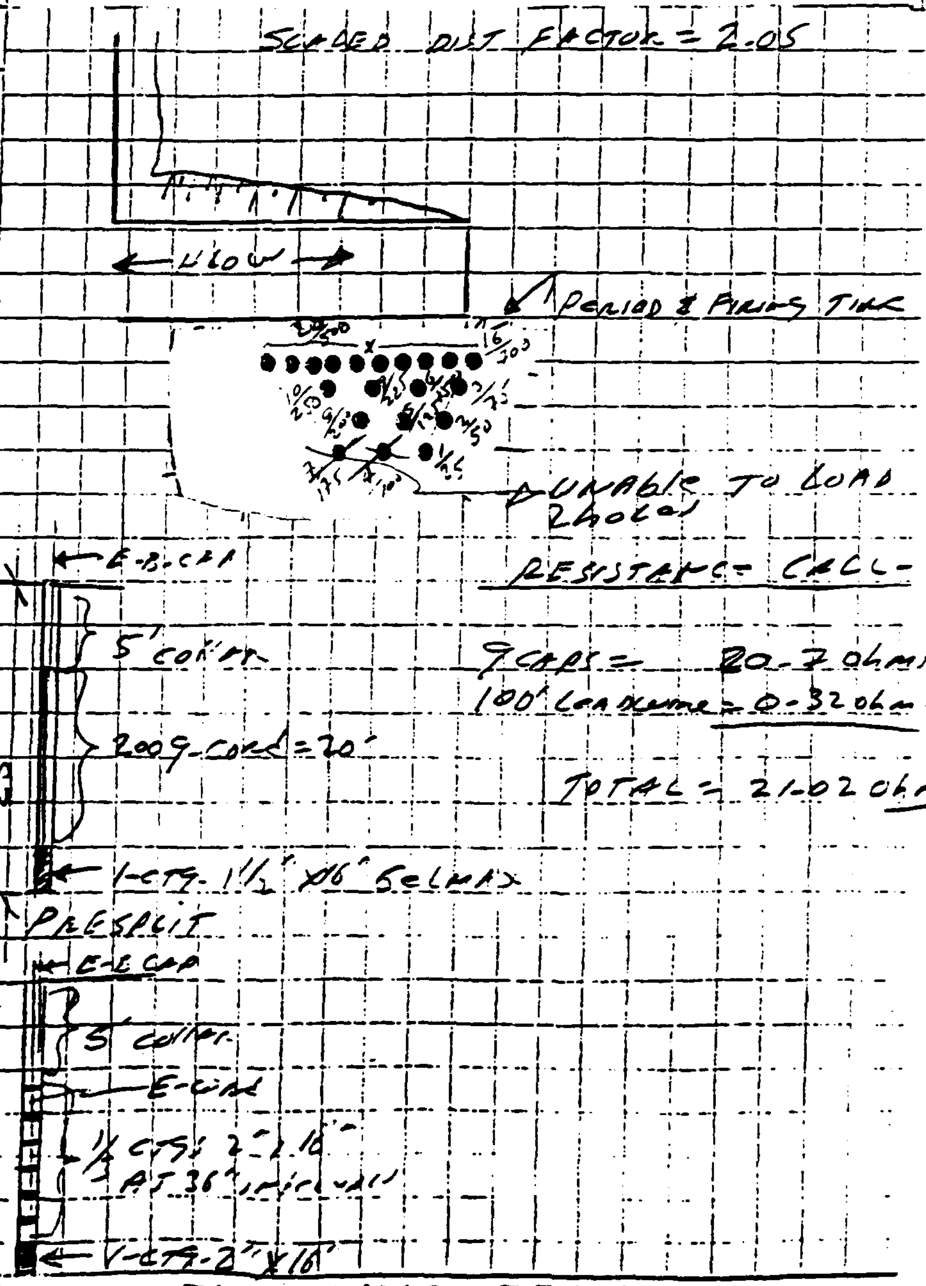
HOLES	SIZE	DEPTH
10	2½"	25'
7	3"	25'

CAPS	LENGTH	EACH
1	24'	1
2		
3		
4		
~~4~~ 5		
~~4~~ 6		
~~4~~ 7		
~~7~~ 8		
~~9~~ 9		
10		
16		
20	24	1

MAX. POUNDS/DELAY: 10.21

REMARKS, DAMAGE FLYROCK, EVALUATION: No fly rock. Peak particle velocities = V = 8.19, T = 1.84, L = 2.13

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



° Adjacent damage
° Existing structures

BLASTING REPORT

PROJECT AS BUILT. SHCT NO.

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47-99-C-0056	McCann	~~2400~~ 1496-2400	Presplit
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
Limestone	33Lb.	178CY. 675Y.	0.19Lb/CY. 0.05Lb/SF = 0.08Lb/
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
11:00 AM	12:30	200: 21:90	

WIND AND WEATHER	Sunny
WATER IN HOLES	N/C
STEMMING	SAND

POWDER TYPE	LBS.
1½"x16" Gelmax	14.7
1"x8" Gelmax	4.8
200grain Cord	4.57

HOLES	SIZE	DEPTH
16	2½"	25'

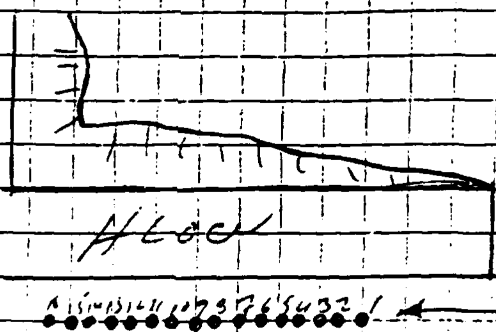
CAPS	LENGTH	EACH
1-16	24'	1

MAX. POUNDS/DELAY
2.06

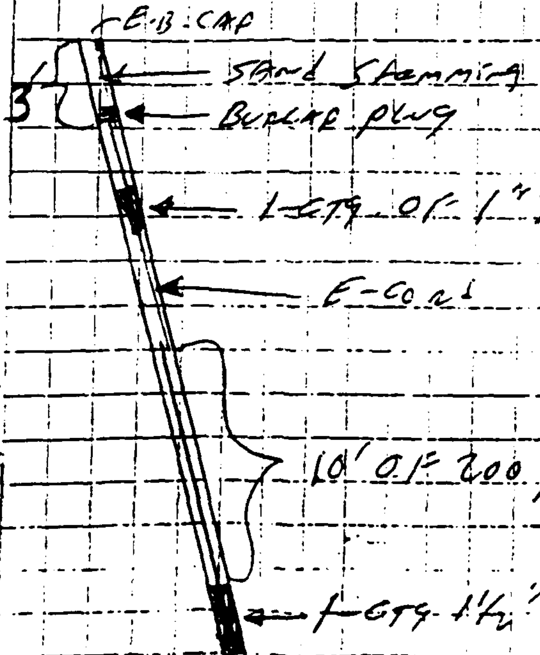
REMARKS, DAMAGE FLYROCK, EVALUATION
NO Fly Good Breakage.

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

Scaled Dist. Factor = 5.58
Series Resistance = 37.4 20 ohms



Presplit Drilled @ 18" c/c



Presplit Holes = 25' deep

BLASTING REPORT

PROJECT | SHOT NO. [illegible]

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW47-89C-0056	McCAWS	1400–1440	Production
ROCK TYPE	TOTAL POWDER LBS.	ROCK IN-PLACE C.Y.	POWDER FACTOR
Limestone	50	148 CY.	0.34 lb/cy.
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
10:30 AM	1:00 PM	01-03-91 2:10 PM	[signature]

WIND AND WEATHER: Sunny

WATER IN HOLES: Nil

STEMMING: Drill cuttings

POWDER TYPE	LBS.
2" X 16" Gelmax	50

HOLES	SIZE	DEPTH
40	3"	4'

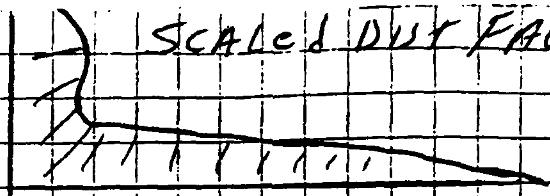
CAPS	LENGTH	EACH
40	24'	1–20

MAX. POUNDS/DELAY: 5 lb.

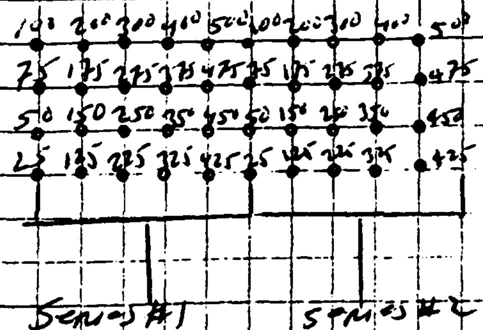
REMARKS, DAMAGE, FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.

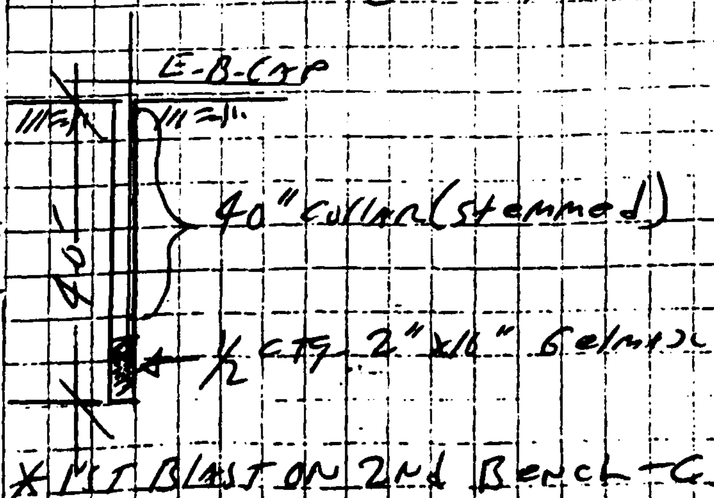
SCALED DIST FACTOR = 14-31



FLOW



RESISTANCE = $\frac{20 \times 2.3}{2} + \frac{100}{1000} \times 64 = 23.64$ ohms



* 1st BLAST ON 2nd Bench - G37 -

BLASTING REPORT

G-119

219

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW4789C0056	MCCAWS	2+00 - 2+35	PRODUCTION PRESPLIT
ROCK TYPE	TOTAL POWDER LBS	ROCK IN PLACE C.Y.	POWDER FACTOR
LIMESTONE	58.8 Lb.	95 Y. 16 SY.	
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
1:00	2:30	4:30 [illegible] 1/11/91	[signature]

WIND AND WEATHER

WATER IN HOLES
N/A

STEMMING
Drillcuttings

POWDER TYPE	LBS.
1½"x16" Gelmax	8.8
2"x16" Gelmax	50 Lb.

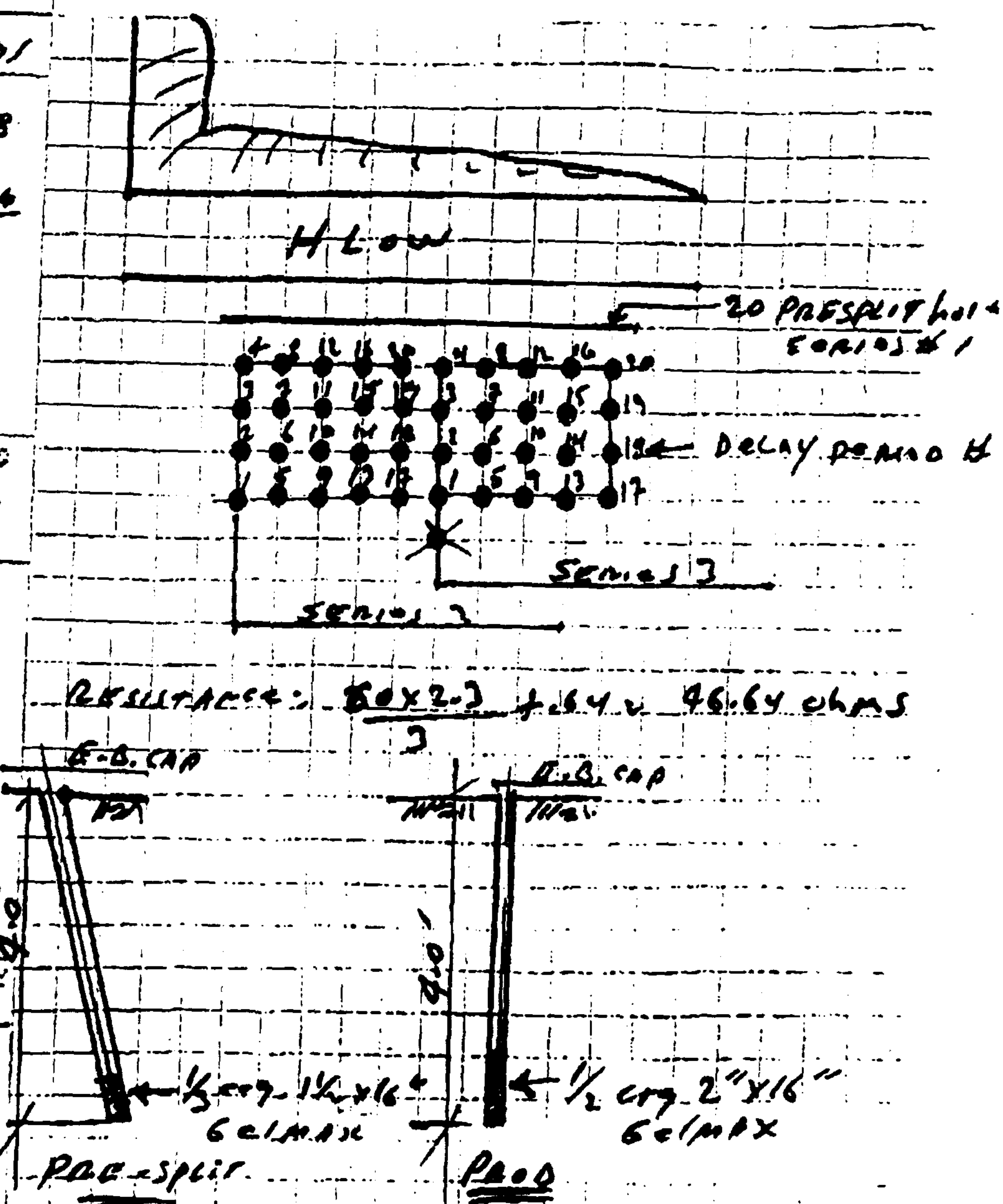
HOLES	SIZE	DEPTH
40	3"	4'
20	2½"	4'

CAPS	LENGTH	EACH
1-20	24'	3

MAX. POUNDS/DELAY
2.5 Lb.

REMARKS, DAMAGE FLYROCK, EVALUATION
Reading 44.
No FLY Rock

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



BLASTING REPORT

PROJECT 1/14/91 SHOT NO. 6-37-24

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW4789C0056	MCCAWS	3T50 +0 3T75.	PRODUCTION PRESPLIT
ROCK TYPE	TOTAL POWDER LBS	ROCK IN PLACE C.Y.	POWDER FACTOR
LIMESTONE	32.54 LB.	51 CY 45Y	0.64LB-CY. 0.42LB-SF 2.11 LB/LF
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
230			K. Lee

WIND AND WEATHER

WATER IN HOLES
NIL

STEMMING
DRILL CUTTINGS

POWDER TYPE	LBS.
1"x8" Gelmax	3.13 LB.
1½"x16" Gelmax	4.41 LB.
2"x16" Gelmax	25 LB.

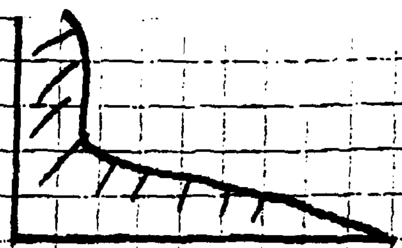
HOLES	SIZE	DEPTH
2½" 6	10 EA	3'
10	2½"	4'
20	3"	4'

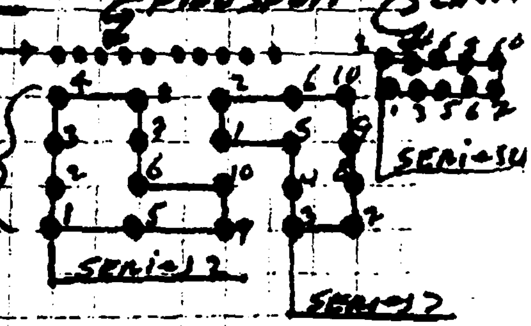
CAPS	LENGTH	EACH
1-10	24'	2
1-20	24'	1

MAX. POUNDS/DELAY
2.5

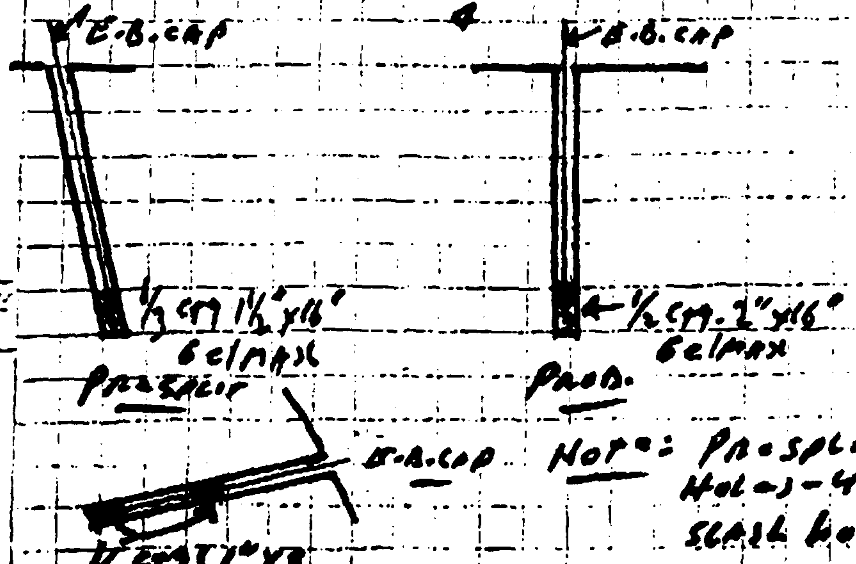
REMARKS, DAMAGE FLYROCK, EVALUATION

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.





RESISTANCE = 10X2.3 / 4 + .64 = 6.39 ohms



NOTE: PRESPLIT & PROD. Holes - 4' deep.
SLASH holes 3' deep.

BLASTING REPORT

G-121

PROJECT 1/16/91 SHOT NO. 5 C 24

CONTRACT NO.	CONTRACTOR	STATION AND RANGE	WORK FEATURE
DACW 47 89 C 0056	MCCAWS	2+60 TO 3+00	PRODUCTION PRESPLIT
ROCK TYPE	TOTAL POWDER (LBS)	ROCK IN PLACE C.Y.	POWDER FACTOR
LIMESTONE	37 lbs	57 CY 7 SY.	0.65 lbs-CY. 0.07 lbs/SF = 0.11 lbs/c
LOADING START	LOADING FINISH	TIME AND DATE FIRED	SIGNATURE
900	11:00	1650 AM 1/17/91	

WIND AND WEATHER

WATER IN HOLES
NIL

STEMMING
DRILL CUTTINGS

POWDER TYPE	LBS.
1½"x16" Gelmax	~~7~~ 7.5
2"x16" Gelmax	30

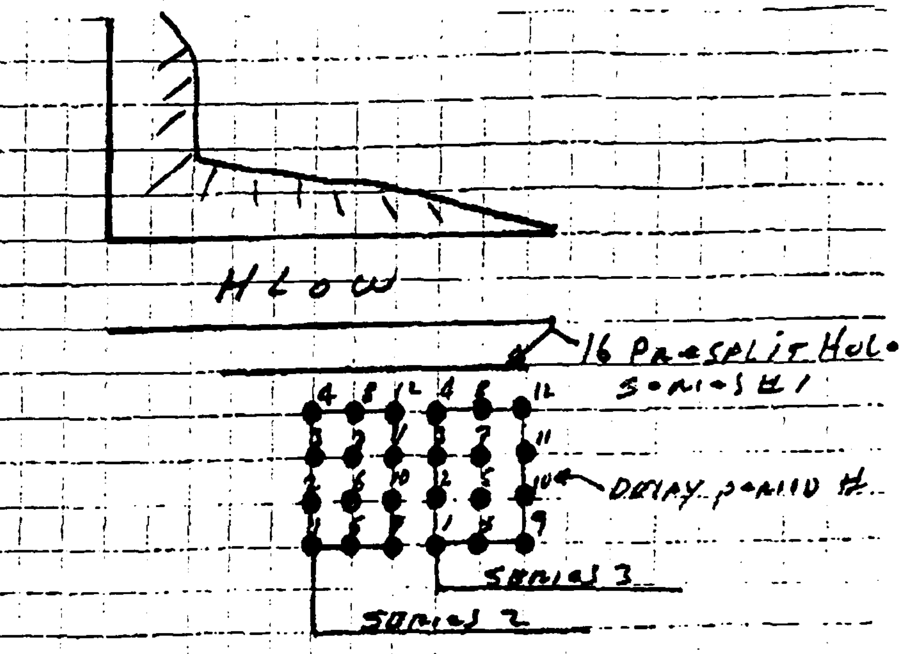
HOLES	SIZE	DEPTH
16	2½"	4'
24	3"	4'

CAPS	LENGTH	EACH
1-12	24	2
1-16	24	1
1-S	24	1

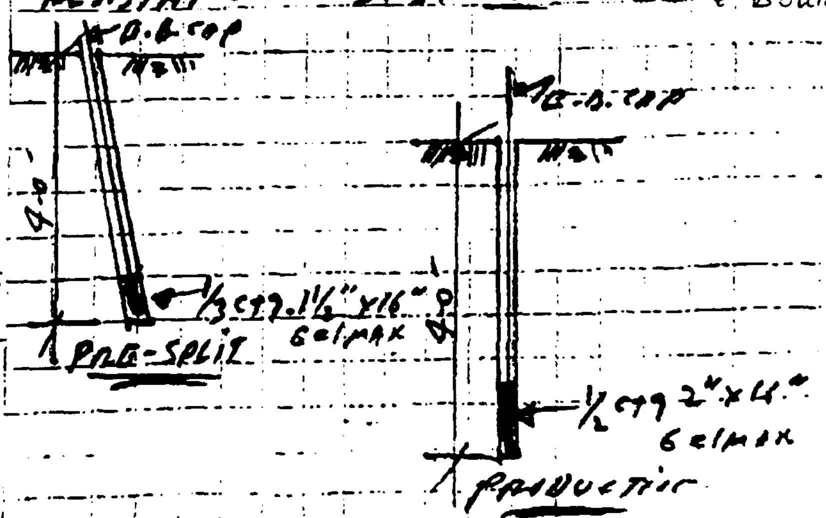
MAX. POUNDS/DELAY
2.5

REMARKS, DAMAGE, FLYROCK, EVALUATION
NO Reading
Fly Rock
NO mats.

SHOW: PLAN AND SECTION VIEWS; STATIONING AND DIMENSIONS; PATTERN, DELAYS, HOLE ANGLES, TYPICAL CHARGE, STEMMING, SUB-DRILL REPORT INDIVIDUAL HOLE LOADINGS ON BACK, IF REQUIRED.



RESISTANCE = 31.31 ohms   Five Boulders



BLASTING REPORT

Seismograph Records and Selected Readouts

PCL CIVIL CONSTRUCTORS, INC.
Construction Since 1906

DEC 5 1990

December 3, 1990

Serial Letter No.: 543/FAR 52.243/4

U.S. Army Corps of Engineers
P.O. Box 551
Truth or Consequences, NM 87901

Attn: Mr. Wiley S. Isom, II

Reference: Contract No. DACW47-89-C-0056 (Cuchillo Dam)
Rio Grande Floodway
T or C, NM

Subject: Change Item No. 24: Remove Differing Site Condition Material
Corps File No. "C-37"
Seismograph Calibration Certificates

Gentlemen:

Enclosed please find copies of the Certificates of Calibration for the three (3) seismographs presently being employed in the prosecution of the aforesaid subject change.

Should any questions arise concerning this above please contact the undersigned at this office.

Sincerely,

Thomas R. O'Donnell
Project Manager

Certificate of Calibration

This certifies that this instrument has been calibrated according to methods established by Thomas Instruments Inc., and that the results are consistent with the specifications published regarding the instrument. Details regarding the calibration methods are available upon request. Thomas Instruments Inc. also recommends that this instrument be calibrated every twelve months to ensure the accuracy of measurements.

Test Equipment Utilized in Calibration

Bruel & Kjaer Uni-Gain Accelerometer Type 4370	S/N 1319148
Bruel & Kjaer Charge Amplifier Type 2635	S/N 1339766
Bruel & Kjaer Vibration Exciter Type 4809	S/N 1342915
Bruel & Kjaer Power Amplifier Type 2706	S/N 1353929
Bruel & Kjaer Pistonphone Type 4220	S/N 1297540
B & K (Dynascan Corp) Sweep Function Generator Type 3030	S/N 46-23822
Leader Digital Counter LDC-824S	S/N 7090109

Instrument Model Number: VMS-500

Instrument Serial Number: V5-0250059

TECHNICIAN

25 JULY 1990
DATE

THOMAS INSTRUMENTS INC.
SPOFFORD, NH 03462

Certificate of Calibration

This certifies that this instrument has been calibrated according to methods established by Thomas Instruments Inc., and that the results are consistent with the specifications published regarding the instrument. Details regarding the calibration methods are available upon request. Thomas Instruments Inc. also recommends that this instrument be calibrated every twelve months to ensure the accuracy of measurements.

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Bruel & Kjaer Charge Amplifier Type 2635	S/N 1339766
Bruel & Kjaer Vibration Exciter Type 4809	S/N 1342915
Bruel & Kjaer Power Amplifier Type 2706	S/N 1353929
Bruel & Kjaer Pistonphone Type 4220	S/N 1297540
B & K (Dynascan Corp) Sweep Function Generator Type 3030	S/N 46-23822
Leader Digital Counter LDC-824S	S/N 7090109

Instrument Model Number: VMS-500

Instrument Serial Number: V5-I079008

Douglas White
TECHNICIAN

12 FEBRUARY 1990
DATE

THOMAS INSTRUMENTS INC
SPOFFORD, NH 03462

Certificate of Calibration

This certifies that this instrument has been calibrated according to methods established by Thomas Instruments Inc., and that the results are consistent with the specifications published regarding the instrument. Details regarding the calibration methods are available upon request. Thomas Instruments Inc. also recommends that this instrument be calibrated every twelve months to ensure the accuracy of measurements.

Test Equipment Utilized in Calibration

Bruel & Kjaer Uni-Gain Accelerometer Type 4370	S/N 1319148
Bruel & Kjaer Charge Amplifier Type 2635	S/N 1339766
Bruel & Kjaer Vibration Exciter Type 4809	S/N 1342915
Bruel & Kjaer Power Amplifier Type 2706	S/N 1353929
Bruel & Kjaer Pistonphone Type 4220	S/N 1297540
B & K (Dynascan Corp) Sweep Function Generator Type 3030	S/N 46-23822
Leader Digital Counter LDC-824S	S/N 7090109

Instrument Model Number: VMS-500

Instrument Serial Number: V5-L069020

TECHNICIAN

15 JUNE 1990

DATE

THOMAS INSTRUMENTS INC

SPOFFORD, NH 03462

McCaw's Drilling & Blasting Ltd.	Reference: SEISMOGRAPH READINGS BLAST C-37-3	Date: 11-04-90 By: K.S. Sheet 1 of 1

ATT- J. MICHAELS
PCL CONSTRUCTORS

SEISMOGRAPH RESULTS - BLAST C-37-3

(1) LOW LEVEL OUTLET WORKS
- MACHINE DID NOT TRIGGER

(2) HLOW - CONCRETE

PEAK VECTOR SUM-VIBRATION = 0.30" PER SEC.

ENERGY RATIO - VERTICAL = .000216
" " - TRANSVERSE = .00006
" " - RADIAL = .00003

(3) HLOW - 6' FROM PRESPLIT LINE

- PEAK VECTOR SUM - VIBRATION = 71.23 MM/SEC = 2.79 IN./SEC

ENERGY RATIO - VERTICAL = 0.0001
" " - TRANSVERSE = 0.0200
" " - RADIAL = 0.0300

PLEASE ATTACH TO SEISMOGRAPH PRINTOUTS & FORWARD TO CONTRACTING OFFICER.

K.S.

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

SET-UP INFORMATION

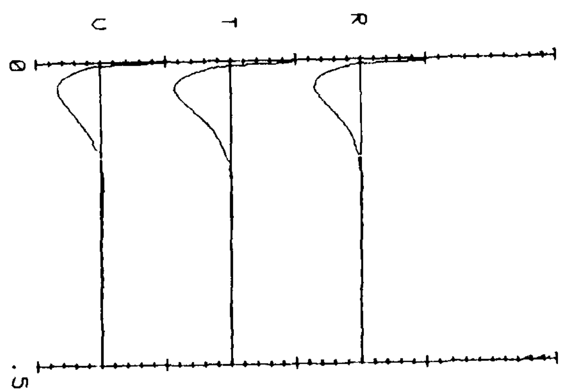
MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .00029 psi
RECORD TIME: 2 second(s)

START TIME: 13:04:45 12-04-1990
FINISH TIME: 09:57:58 11-29-1990

** TRIGGER LEVEL WAS NOT EXCEEDED **
** DURING MONITORING INTERVAL **

SERIAL# U5-1079008
CALIBRATED BY:
THOMAS INSTRUMENTS, SPOFFORD, NH USA
FEBRUARY 12,1990

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCI

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .0029 psi 120 db
RECORD TIME: 2 second(s)

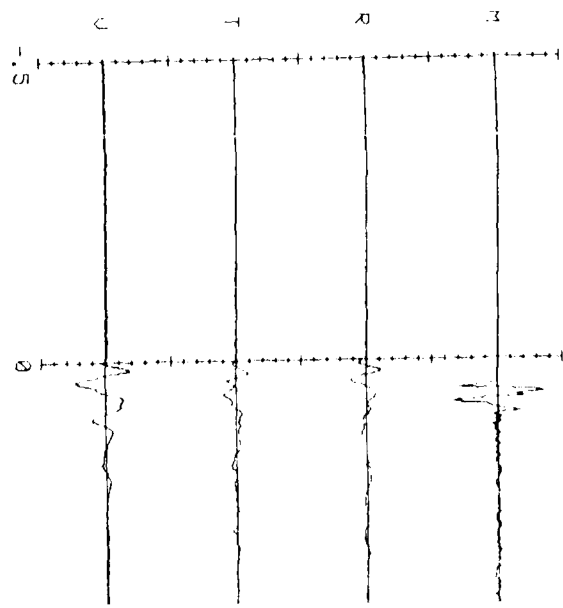
TRIGGERED at 14:01:09 12-04-1990

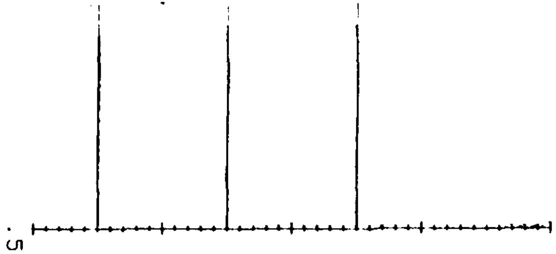
MEASUREMENTS

	V	T	R
PPV (in/s)	.25	.11	.14
TIME (ms)	33	54	33
FREQ (Hz)	17	14	27
PPA (g)	2.74	2.46	.93

PVS (in/s) .3 (33 ms)
PSPL (psi) .0212708 (137 db)

SERIAL#:U5-L069020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990



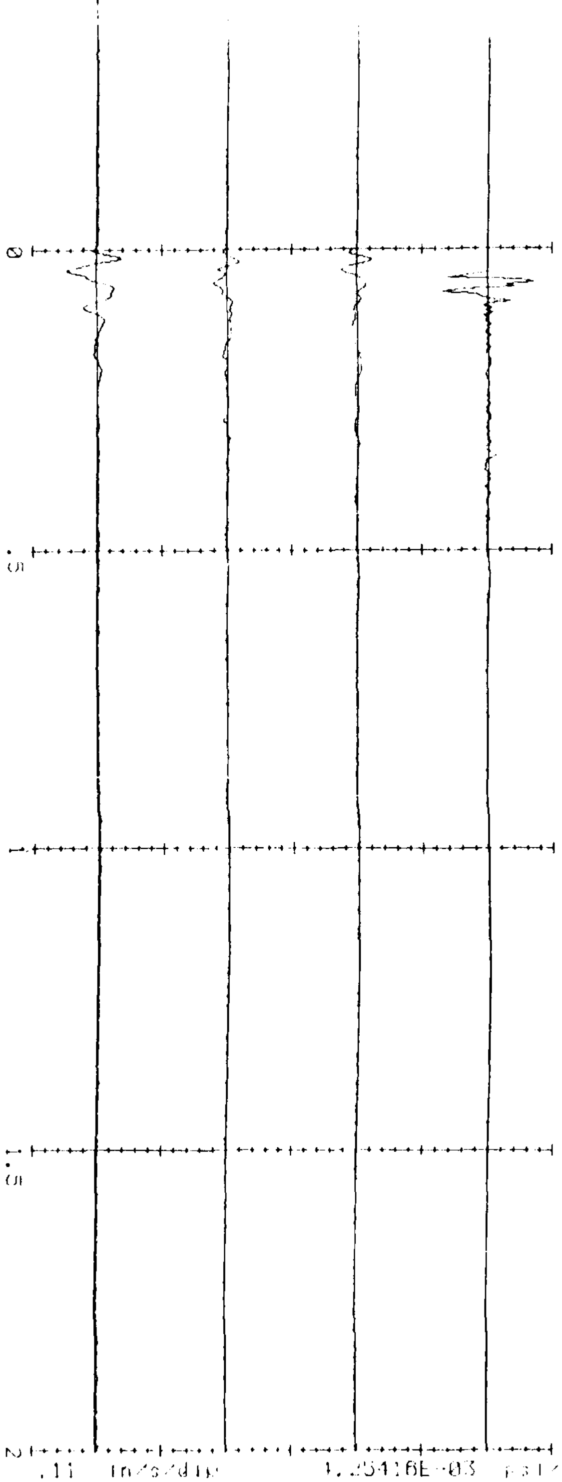


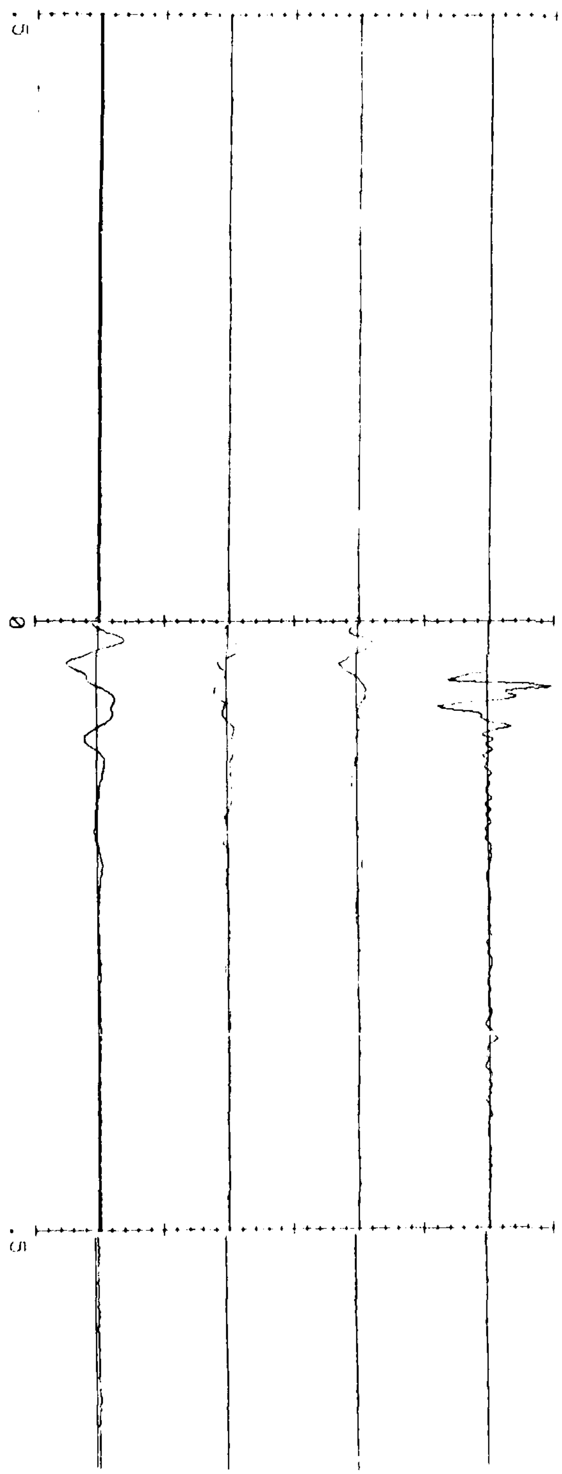
SEISMOGRAPH LOG

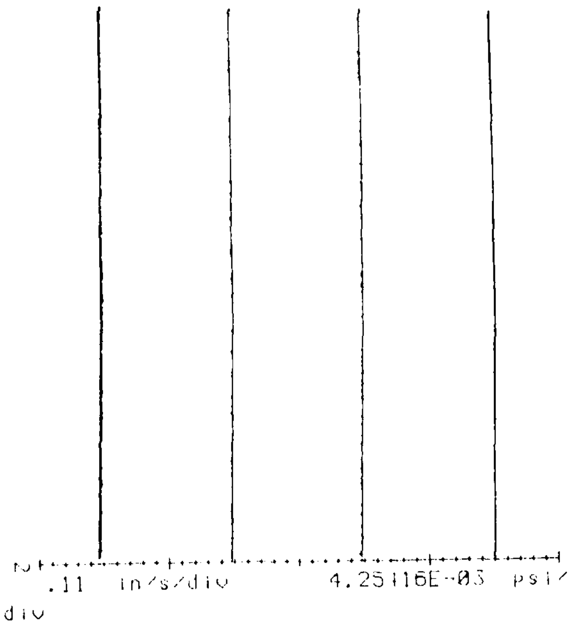
PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON-MCCAWS DRILLING (USA
)
SEISMOGRAPH LOCATION
  LLOW
  ^
DISTANCE FROM SENSOR TO BLAST
  200
NOTES
  BLAST

BLASTING LOG

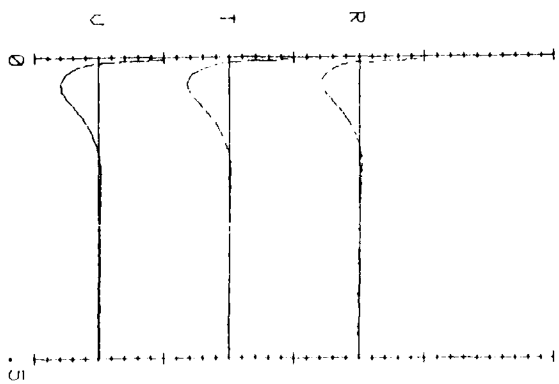
EXPLOSIVES SPECIFICATIONS
  GELMAX 1.5 +16 200FT CORD 200 GRAIN
TOTAL WEIGHT OF EXPLOSIVES USED
  13.5
NUMBER OF CAPS
  1
NUMBER OF DELAYS
  0
MAX WEIGHT/DELAY
  13.5
AVERAGE DEPTH OF HOLE
  25FT
NUMBER OF HOLES
  10
SPACING & BURDEN
  24 INCHS
TYPE OF BLAST
  PRE SPLIT
WEATHER
  SUNNY/CALM
MATS,OVERBURDEN,SAND BLANKET
  MATS





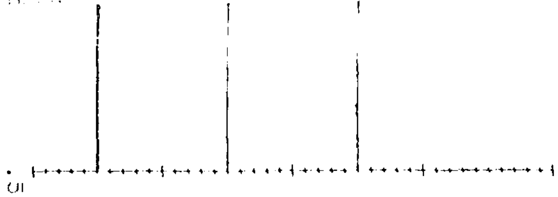


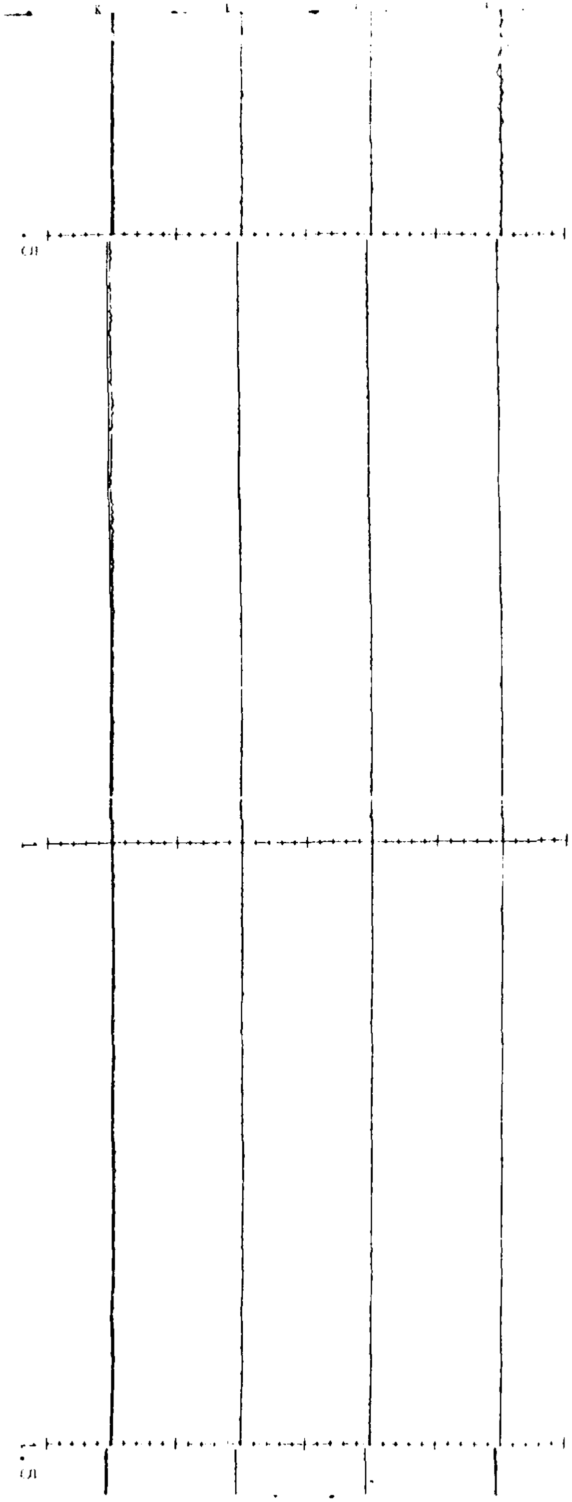
SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
ERDI
OPERATOR
KEVIN STEVENSON



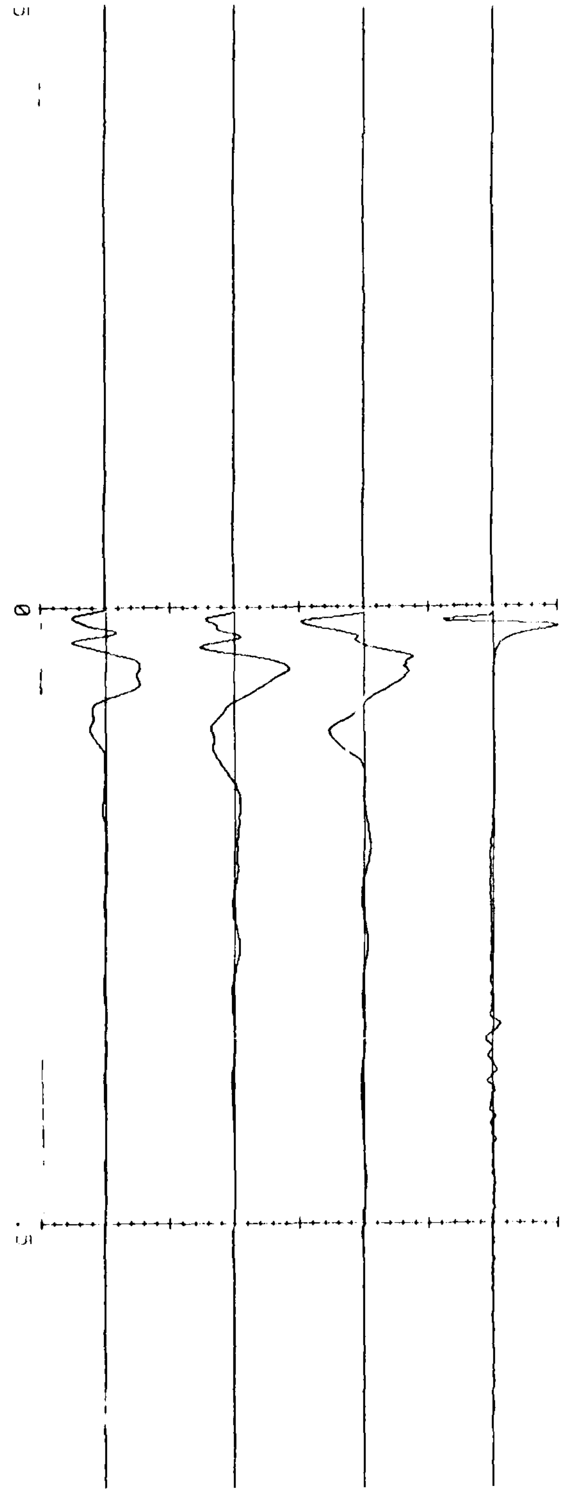


SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  RCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HLOW
DISTANCE FROM SENSOR TO BLAST
  65
NOTES
  BLAST C-37-3

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  IGELMAX 1.5+16
TOTAL WEIGHT OF EXPLOSIVES USED
  13.5
NUMBER OF CAPS
  1
NUMBER OF DELAYS
  0
MAX WEIGHT/DELAY
  10
AVERAGE DEPTH OF HOLE
  25
NUMBER OF HOLES
  10
SPACING & BURDEN
  24 INCHS
TYPE OF BLAST
  PRE SPLIT
WEATHER
  SUNNY/CLEAR
MATS,OVERBURDEN,SAND BLANKET
  MATS



SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .51 mm/s
MIC TRIGGER LEVEL: 56.4 Pa 129 db
RECORD TIME: 2 second(s)

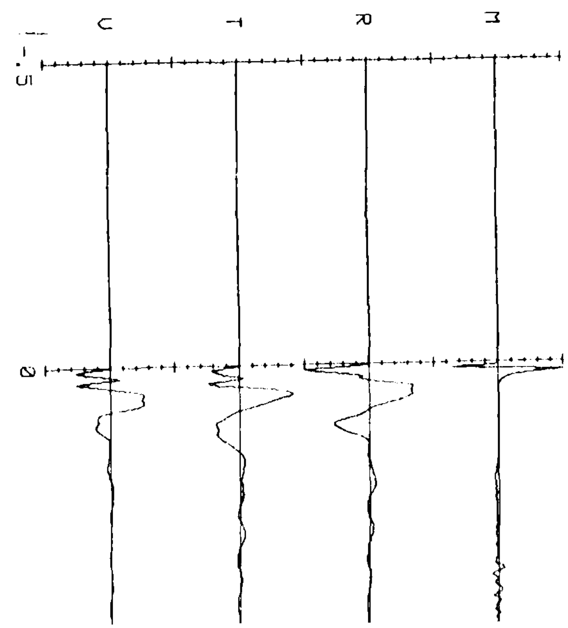
TRIGGERED at 14:02:28 12-04-1990

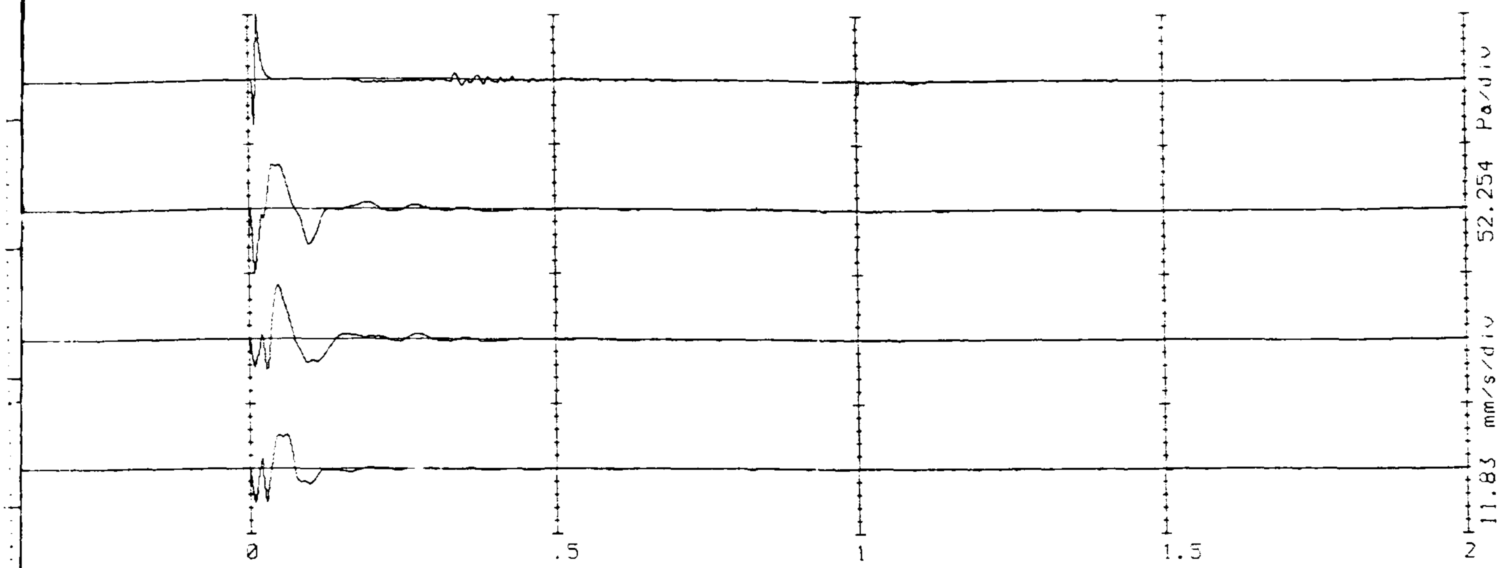
MEASUREMENTS

	V 2.6 in	T 1.94 in	R 2.31 in
PPV (mm/s)	32.25	49.55	59.15
TIME (ms)	61	47	9
FREQ (Hz)	13	13	14
PPA (g)	2.68	.3	2.33

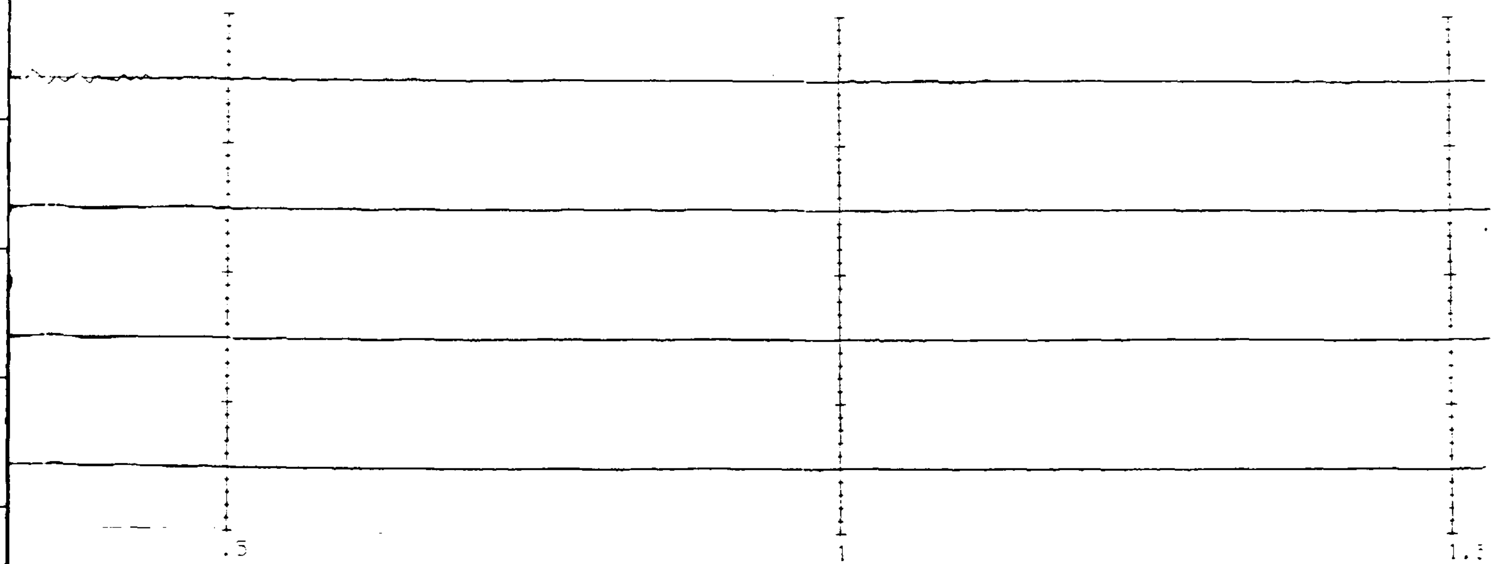
PVS (mm/s) 71.23 (48 ms) 2.8 in
PSPL (Pa) 261.27 (142 db)

SERIAL#:V5-G250059
CALIBRATED BY:
THOMAS INSTRUMENTS, SPOFFORD, NH
JULY 25, 1990

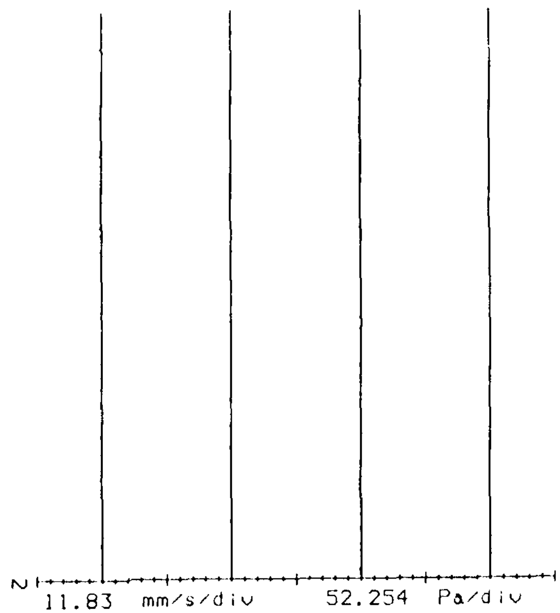




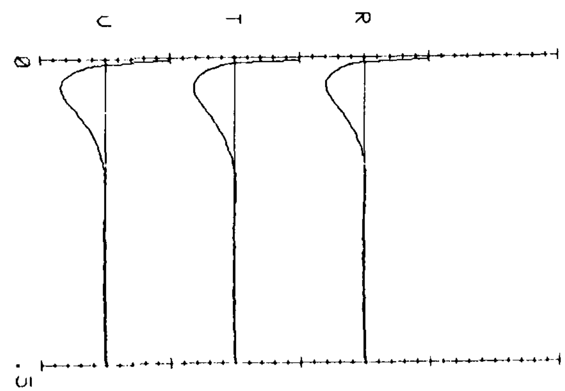
52.254 Pa/div
11.83 mm/s/div
0
.5
1
1.5
2



.5
1

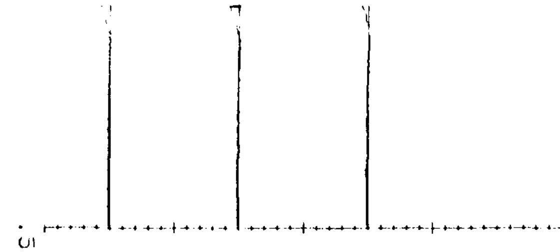


SENSOR TEST



SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION



SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  6FT
DISTANCE FROM SENSOR TO BLAST
  6FT

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  GELMAX 1.5+16
TOTAL WEIGHT OF EXPLOSIVES USED
  13.5
NUMBER OF CAPS
  1
NUMBER OF DELAYS
  0
MAX WEIGHT/DELAY
  13.5
AVERAGE DEPTH OF HOLE
  25FT
NUMBER OF HOLES
  10
SPACING & BURDEN
  24INCHS
TYPE OF BLAST
  PRE SPLIT
WEATHER
  SUNNY
MATS,OVERBURDEN,SAND BLANKET
  MATS

McCaw's Drilling & Blasting Ltd.

Reference:
ATT. J. MICHAELS
RE: BLAST # C37-5
SEISMOGRAPH READINGS

Date: 12-06-90
By: K.J.
Sheet 1 of 1

(1) LOW LEVEL OUTLET WORKS

THIS MACHINE WAS FALSELY TRIGGERED 6 MIN & 18 SEC. BEFORE THE BLAST.

(2) HIGH LEVEL OUTLET WORKS (8" FROM BLAST ON ROCK)

PVS (PEAK VECTOR SUM) - VIBRATION = 0.04"/SEC

ENERGY RATIO - VERTICAL = .00006
" " - TRANSVERSE = .00000008
" " - RADIAL = .0000002

(3) HIGH LEVEL OUTLET WORKS - CONCRETE

PEAK VECTOR SUM - VIBRATION = 0.94"/SEC

ENERGY RATIO - VERTICAL = .0015
" " - TRANSVERSE = 1.00 *
" " - RADIAL = .0001

PLEASE ATTACH PRINTOUTS & FORWARD TO CONTRACTING OFFICER

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603 363 4500

SET UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .0029 psi 120 dB
RECORD TIME: 2 seconds

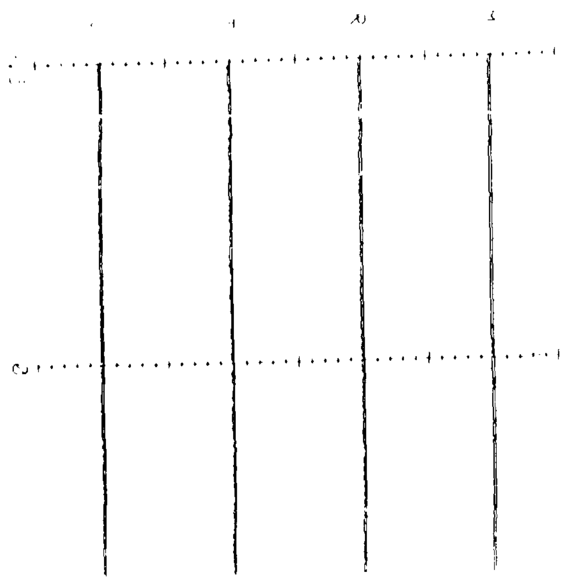
TRIGGERED at 14:1[illegible] 12 [illegible] 1990

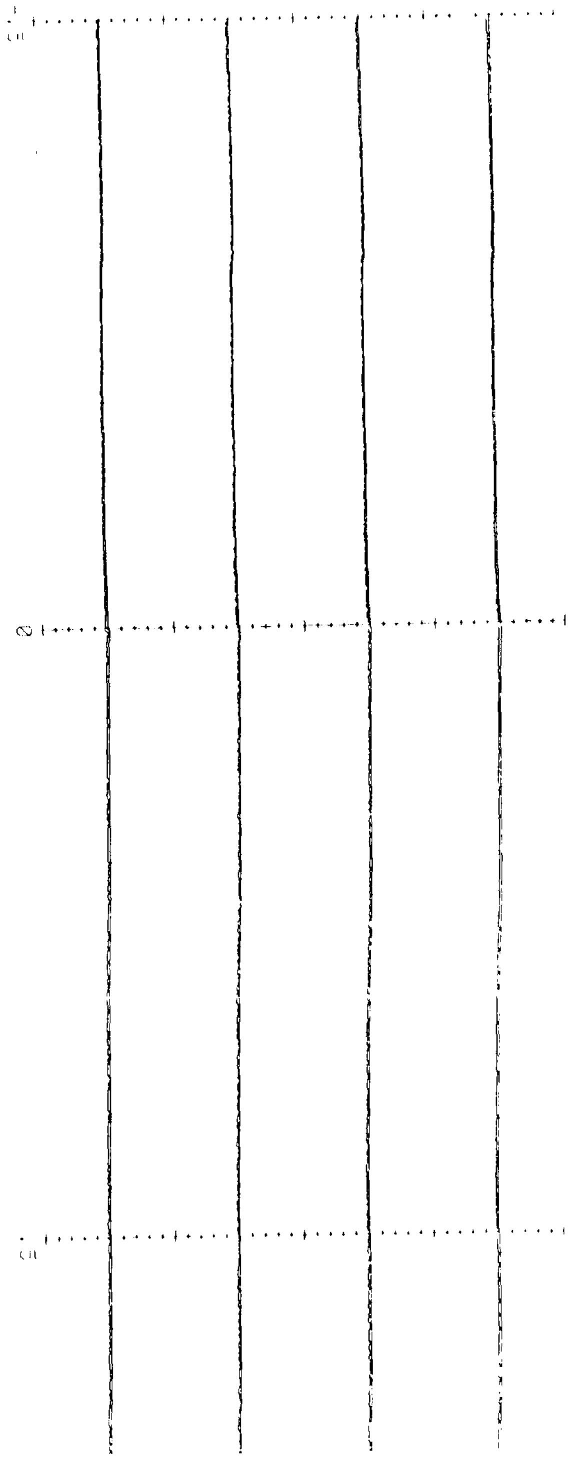
MEASUREMENTS

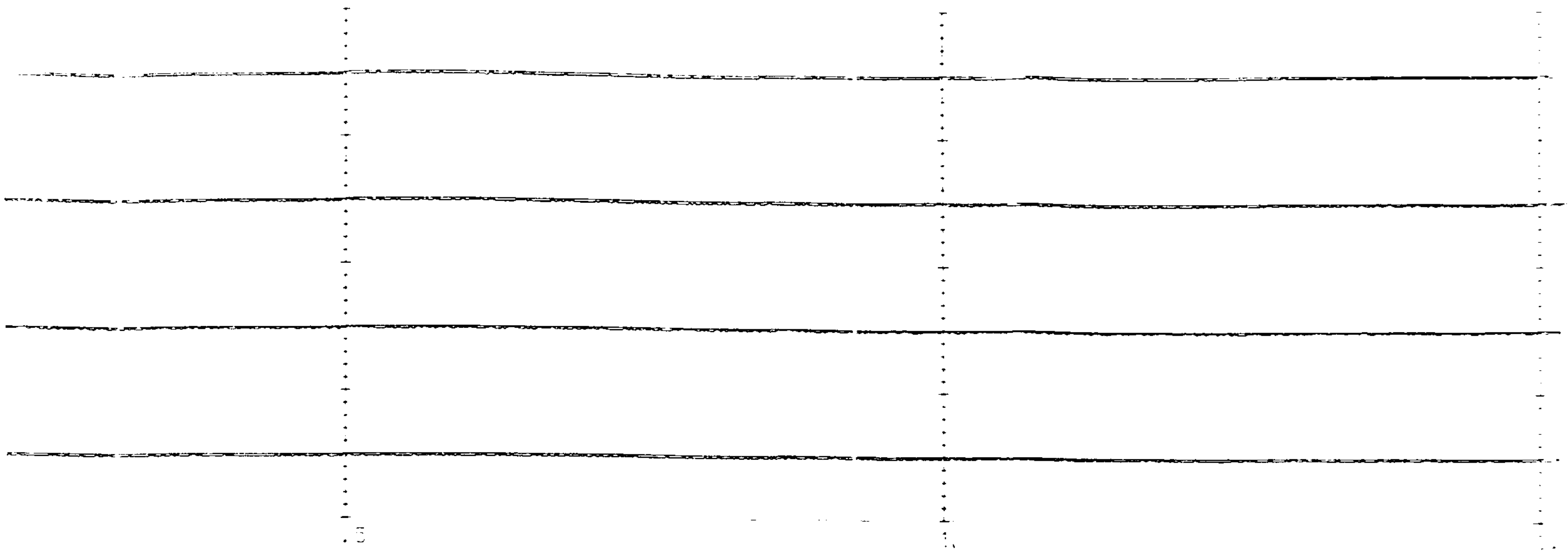
	V	T	R
PPV (in/s)	.03	.02	.02
TIME (ms)	0	42	38
FREQ (Hz)	4	23	43
PPA (g)	3	.26	2.8

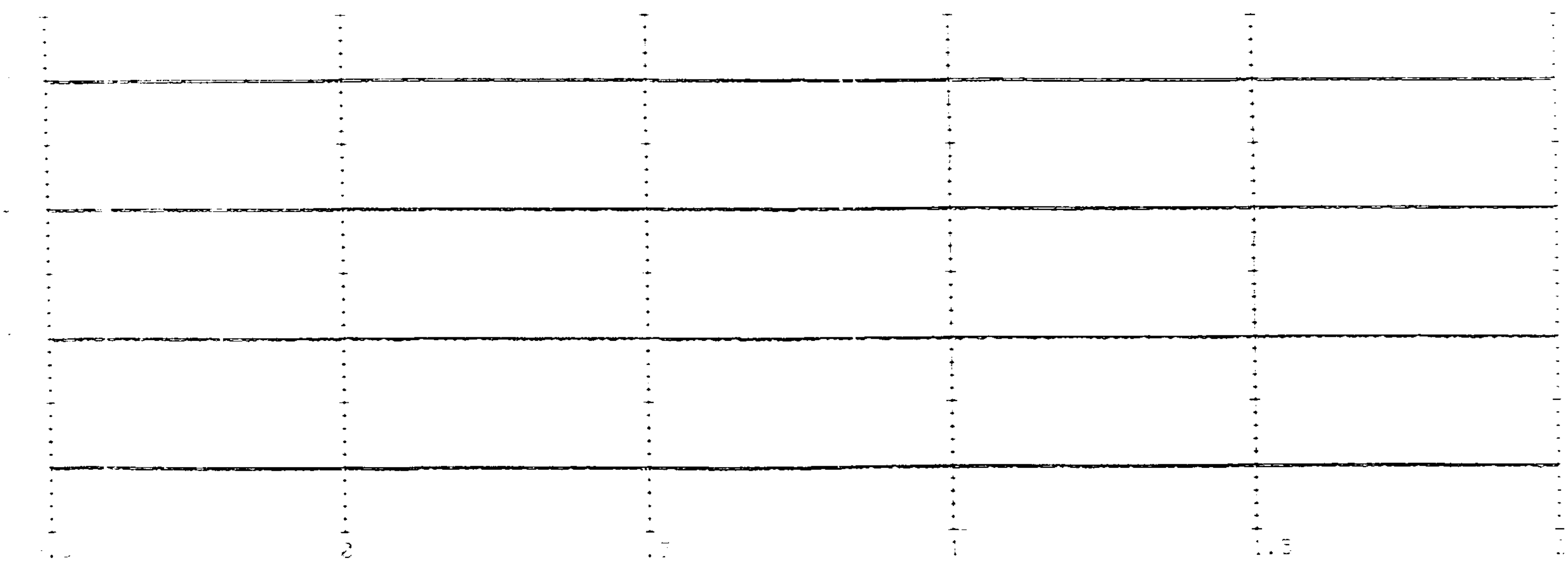
PVS (in/s) .04 (0 ms)
PSPL (psi) .0001316 (93 db)

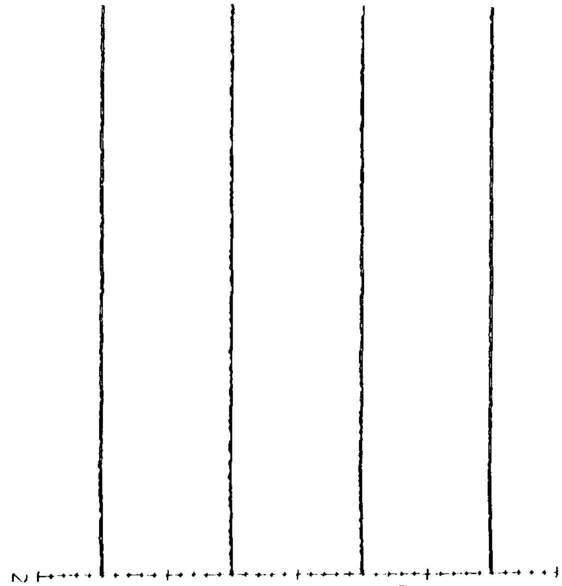
SERIAL#:US-G250059
CALIBRATED BY:
THOMAS INSTRUMENTS, SPOFFORD, NH
JULY 25, 1990



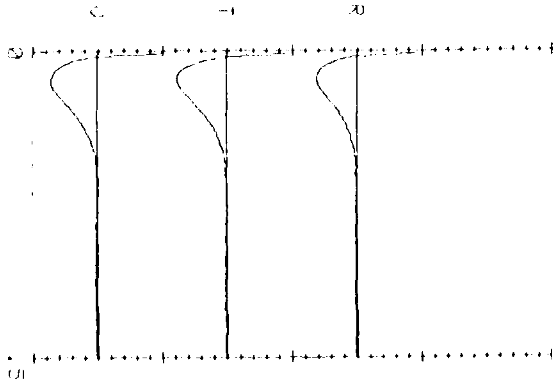








SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .00029 psi
RECORD TIME: 2 second(s)

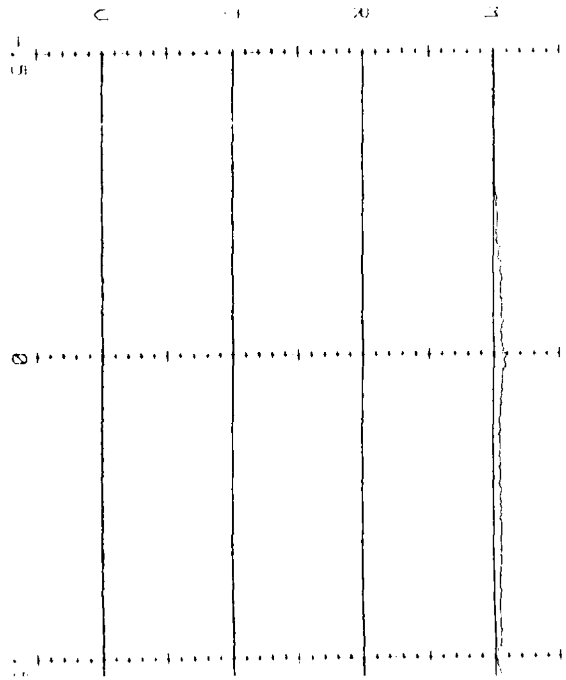
TRIGGERED at 14:10:41 12-06-1990

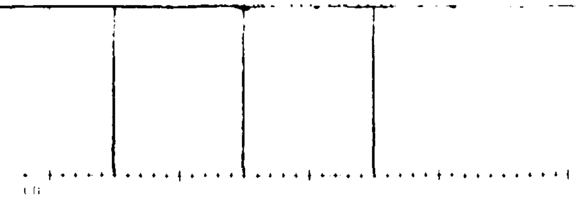
MEASUREMENTS

	V	T	R
PPV (in/s)	.01	.01	.01
TIME (ms)	239	459	766
FREQ (Hz)	256	512	512
PPA (g)	.09	1.85	2.55

PVS (in/s) .02 (1319 ms)
PSPL (psi) .0003256

SERIAL#:V5-I079008
CALIBRATED BY:
THOMAS INSTRUMENTS, SPOFFORD, NH USA
FEBRUARY 12,1990



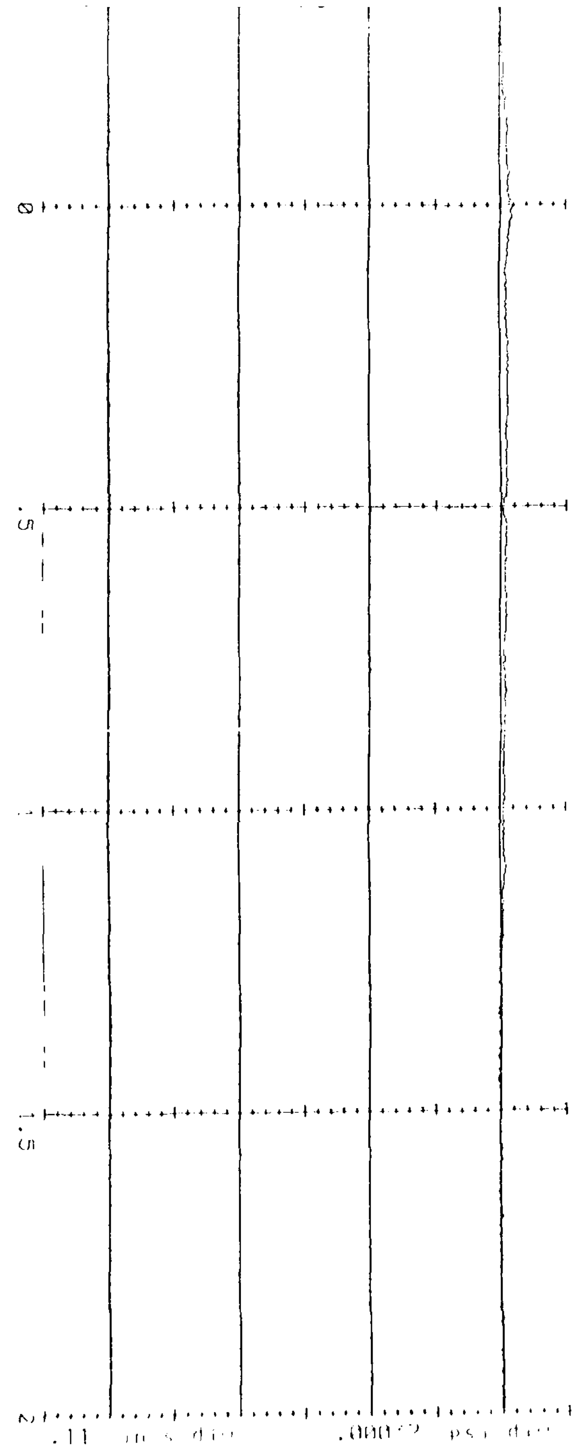


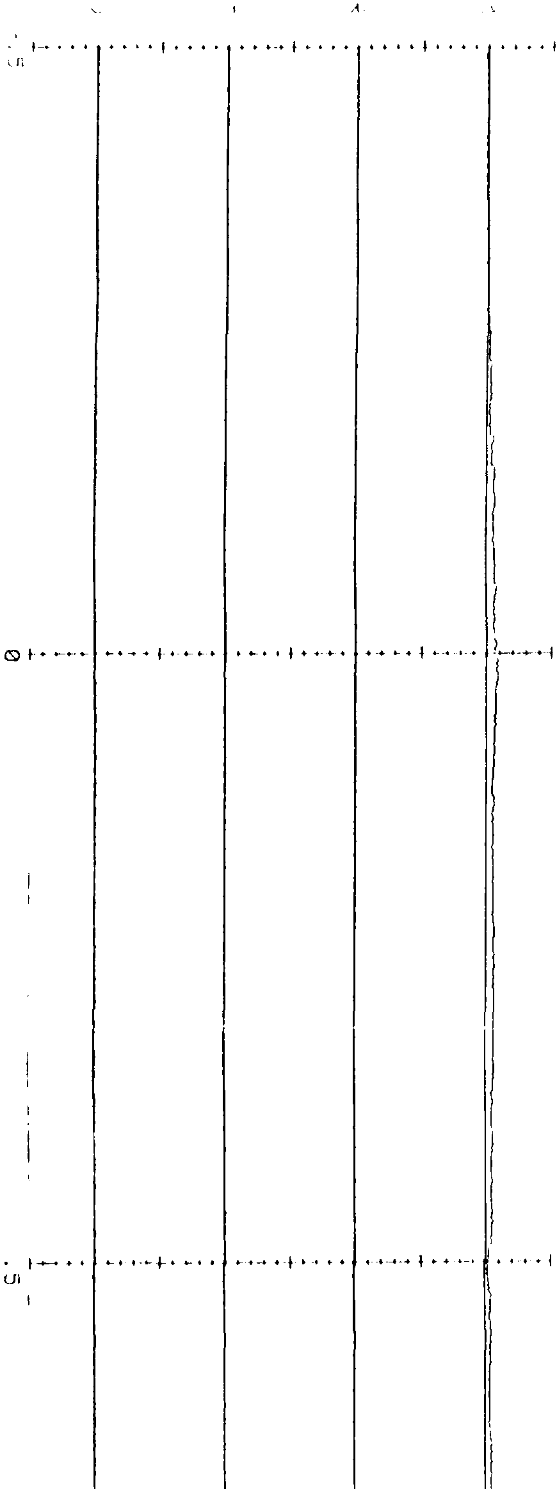
SEISMOGRAPH LOG

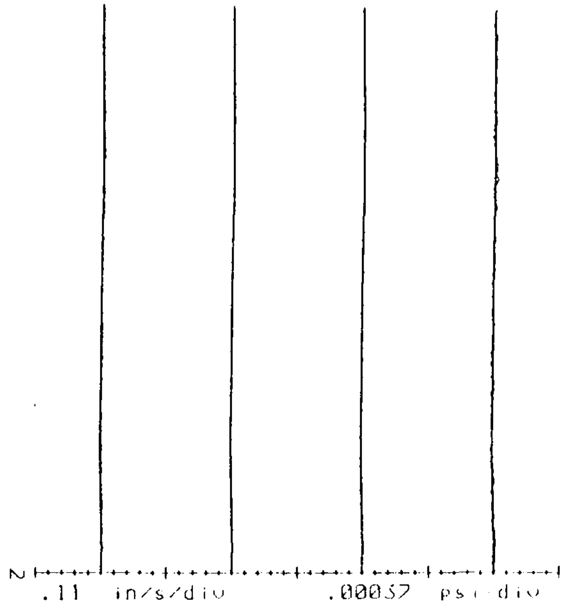
PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
8FT
DISTANCE FROM SENSOR TO BLAST
46
NOTES
BLAST C-32-5

BLASTING LOG

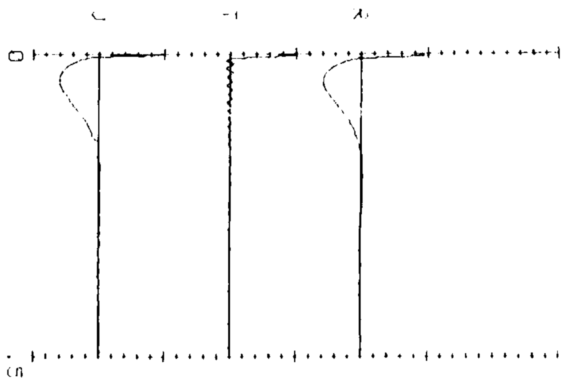
EXPLOSIVES SPECIFICATIONS
GELMAX 1.5+16
200GRAINCORD
TOTAL WEIGHT OF EXPLOSIVES USED
13.5
20.14
NUMBER OF CAPS
1
NUMBER OF DELAYS
0
MAX WEIGHT/DELAY
20.14
AVERAGE DEPTH OF HOLE
.25FT
NUMBER OF HOLES
10
SPACING & BURDEN
24INCHS
TYPE OF BLAST
PRE SPLIT
WEATHER
SUNNY
MATS,OVERBURDEN,SAND BLANKET
MATS





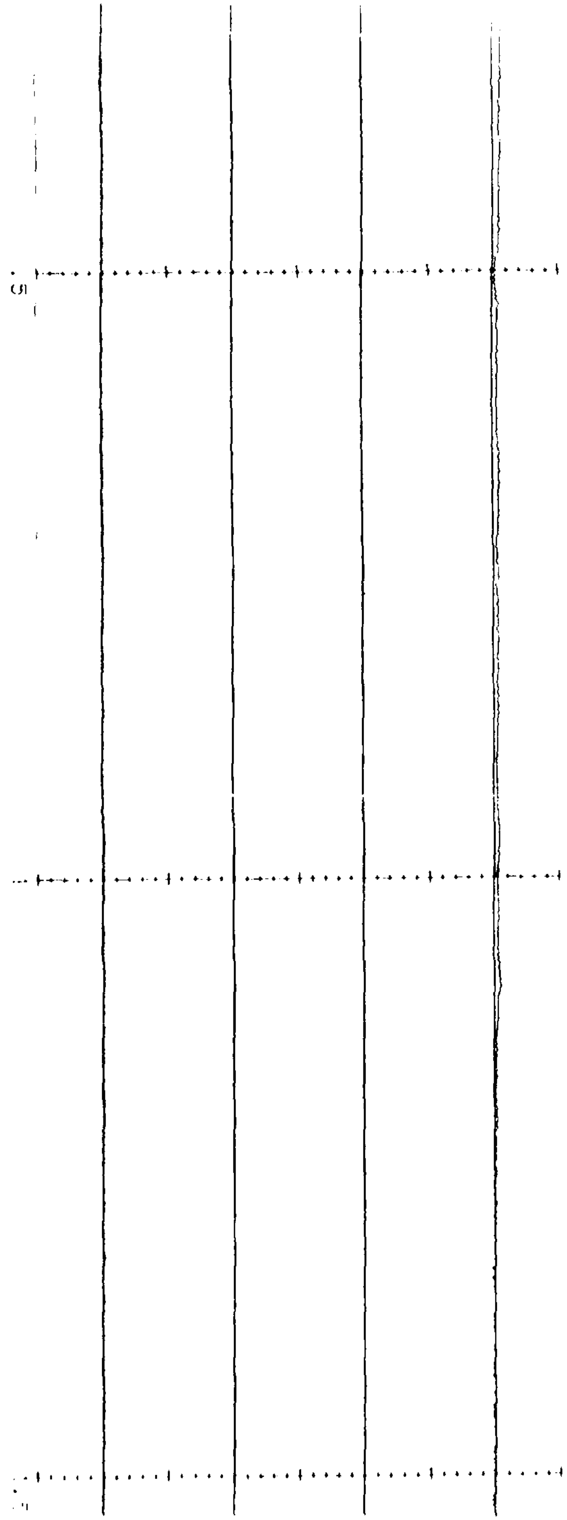


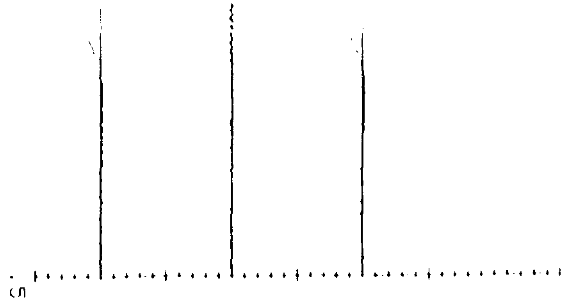
SENSOR TEST



SEISMOGRAPH LOG

PROJECT





SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON-MCCAWS DRI ING (USA
)
SEISMOGRAPH LOCATION
  LLOW
  ^
DISTANCE FROM SENSOR TO BLAST
  200
NOTES
  BLAST C-32 5

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  GELMAX1-1/2+16 200GRAIN COND
TOTAL WEIGHT OF EXPLOSIVES USED
  20.41
NUMBER OF CAPS
  1
NUMBER OF DELAYS
  5
  1
MAX WEIGHT/DELAY
  20.14
AVERAGE DEPTH OF HOLE
  25
NUMBER OF HOLES
  10
SPACING & BURDEN
  24IN
TYPE OF BLAST
  PRE SPLIT
WEATHER
  SUNNY/CALM

SET UP INFORMATION

MODE: Single Event
SOURCE: Geophone or Microphone
GEO TRIGGER LEVEL: .02 in/s
MIC TRIGGER LEVEL: .0023 psi 120 db
RECORD TIME: 2 second(s)

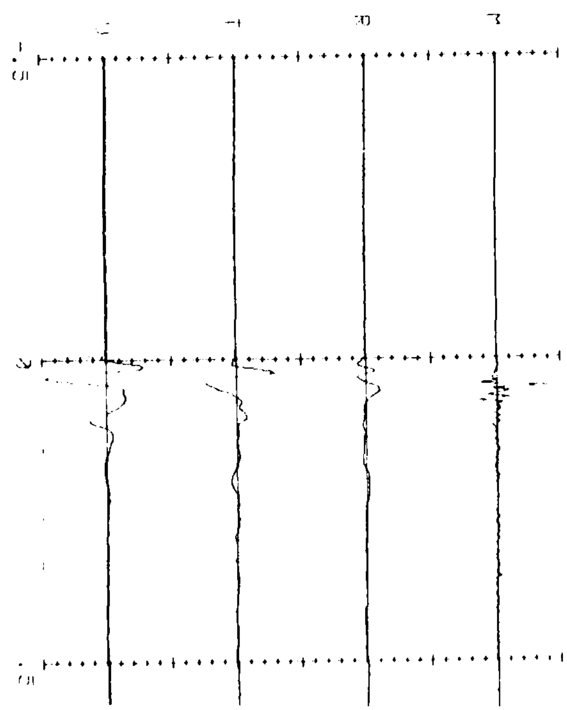
TRIGGERED at 14:16:53 12-06 1990

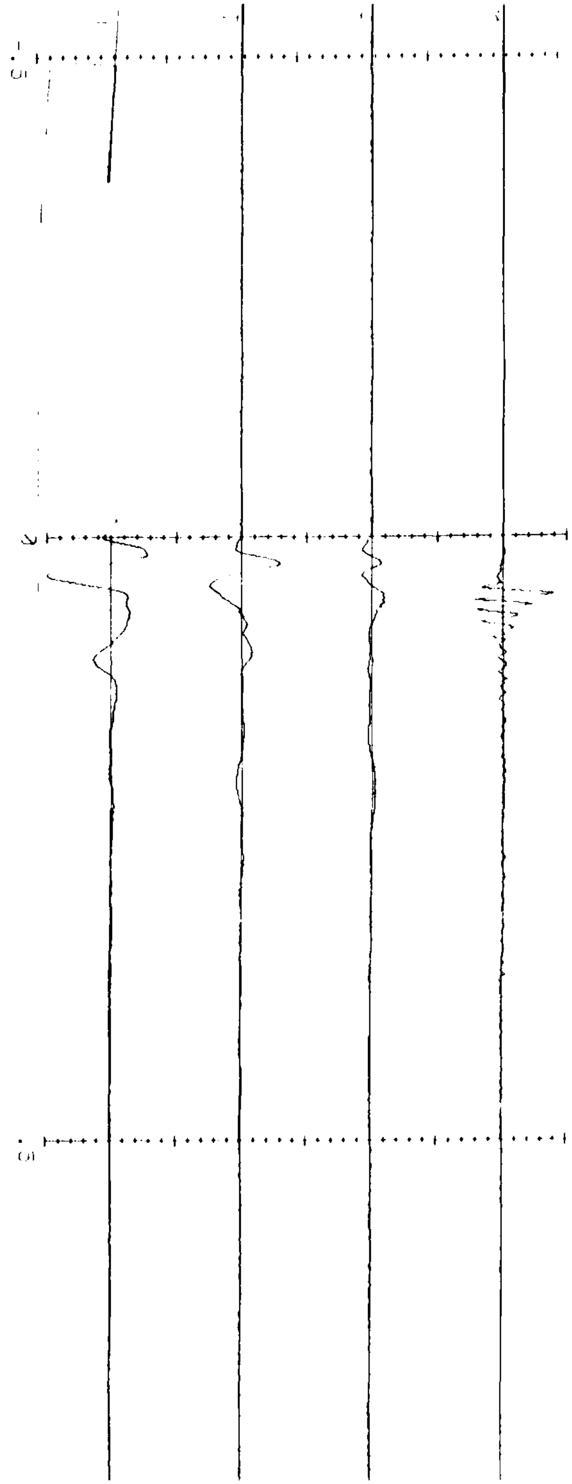
MEASUREMENTS

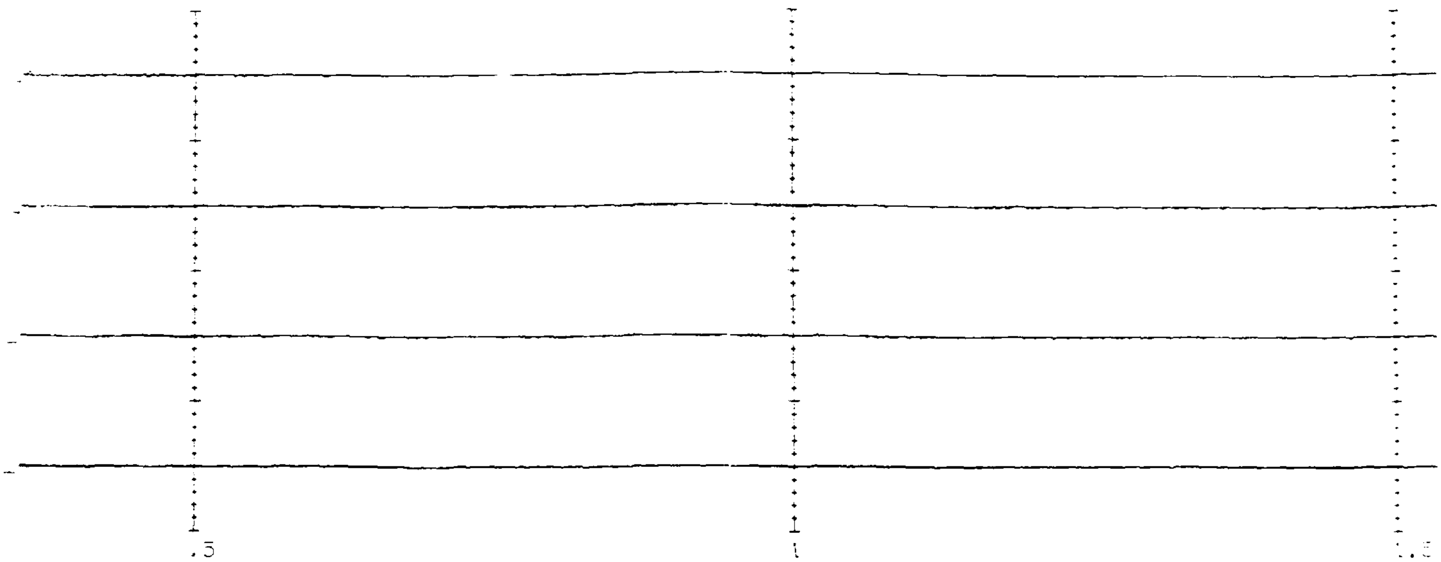
	V	T	R
PPV (in/s)	.88	.53	.18
TIME (ms)	34	22	51
FREQ (Hz)	23	30	16
PPA (g)	2.23	1.36	2.54

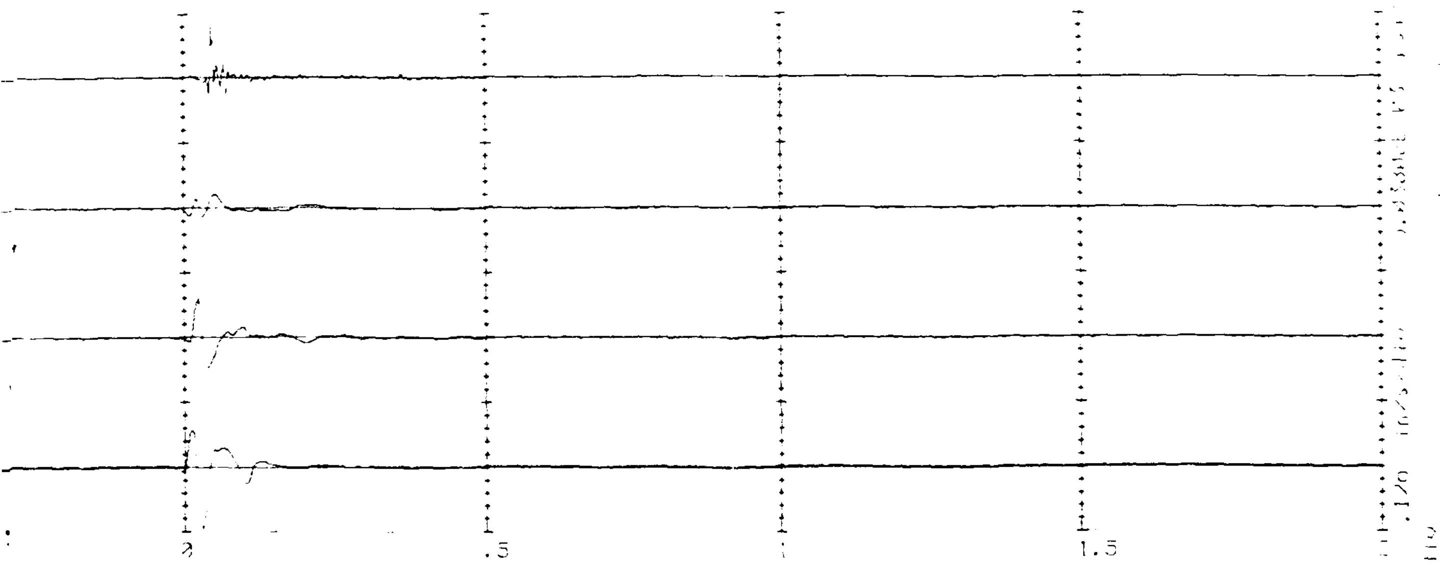
PVS (in/s) .94 (35 ms)
PSPL (psi) .0251904 (139 db)

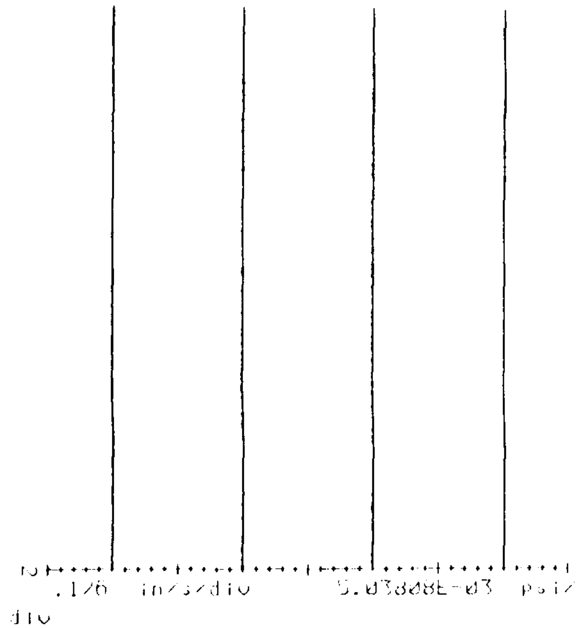
SERIAL#:US-L069020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990



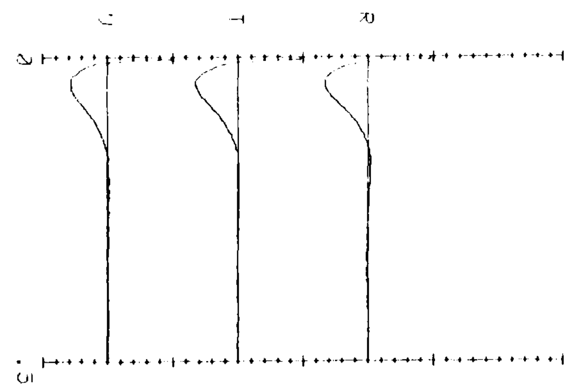






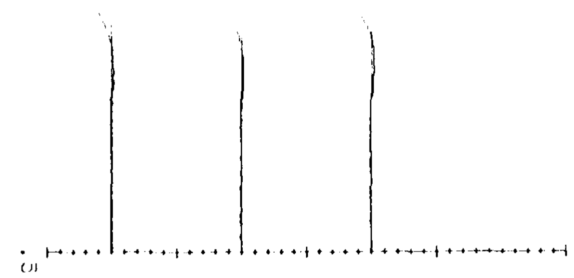


SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CACHILEO DAM
CLIENT
PCI



SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PSI
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HEAD
DISTANCE FROM SENSOR TO BLAST
  461
NOTES
  BLAS C-32-5

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  GELAX 1-1/2 6 200GRAIN COND
TOTAL WEIGHT OF EXPLOSIVES USED
  20.4
NUMBER OF CAPS
  1
NUMBER OF DELAYS
  1
MAX WEIGHT/DELAY
  20.11
AVERAGE DEPTH OF HOLE
  25
NUMBER OF HOLES
  10
SPACING & BURDEN
  24IN
TYPE OF BLAST
  PRE-SPLIT
WEATHER
  SUNNY/CLEAR

CUCHILLO DAM PROJECT
BLAST #C37-8
11 DECEMBER 1990
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 8 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 1.72 in/sec.

ENERGY RATIO - VERTICAL = 0.0107
ENERGY RATIO - TRANSVERSE = 0.0018
ENERGY RATIO - RADIAL = 0.0030

2. LOW LEVEL OUTLET WORKS 160 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.08 in/sec.

ENERGY RATIO - VERTICAL = 0.000000003
ENERGY RATIO - TRANSVERSE = 0.00000244
ENERGY RATIO - RADIAL = 0.00000216

SET-UP INFORMATION

MODE : Single Event
SOURCE :

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE : 603-363-4500

SET-UP INFORMATION

MODE : Single Event
SOURCE : Geophone
GEO TRIGGE

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE : 603-363-4500

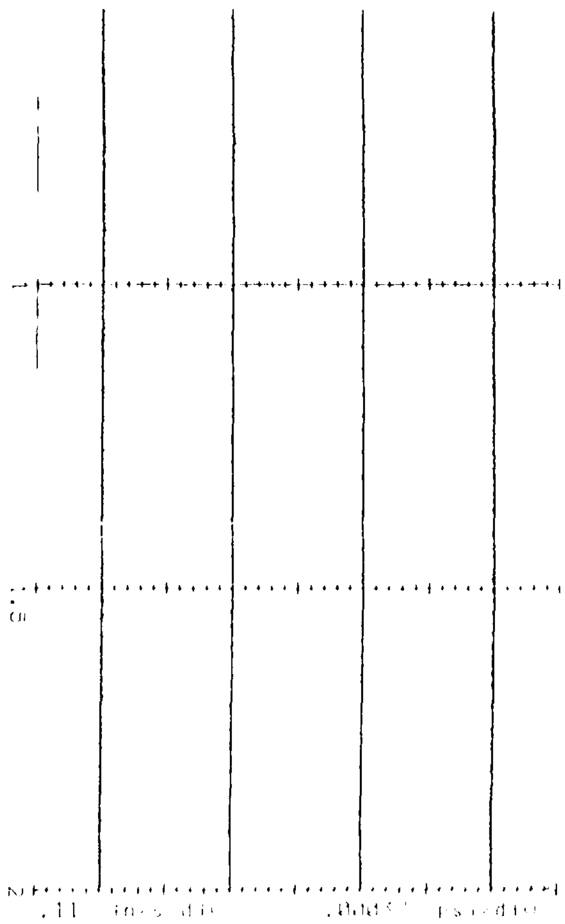
SET-UP INFORMATION

MODE : Single Event
SOURCE : Geophone
GEO TRIGGER LEVEL : .02 in/s
RECORD TIME : 2 second(s)

TRIGGERED at 12:44:42 12-11-1990

MEASUREMENTS

U T R



SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 2 second(s)

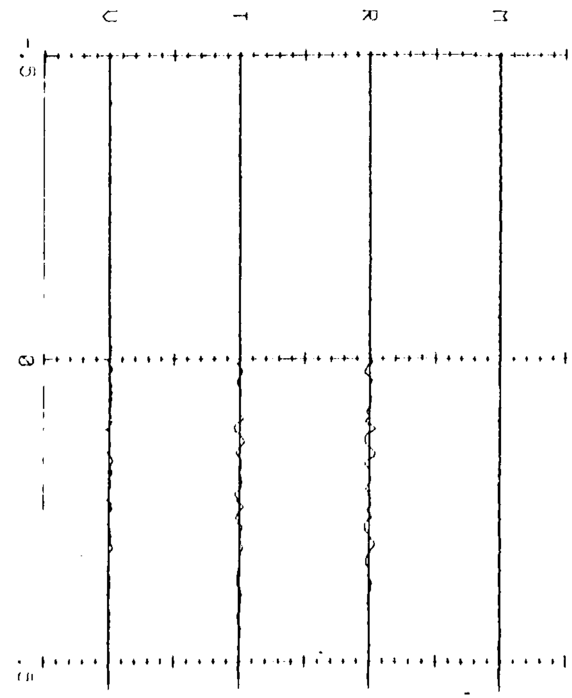
TRIGGERED at 12:44:42 12 11-1990

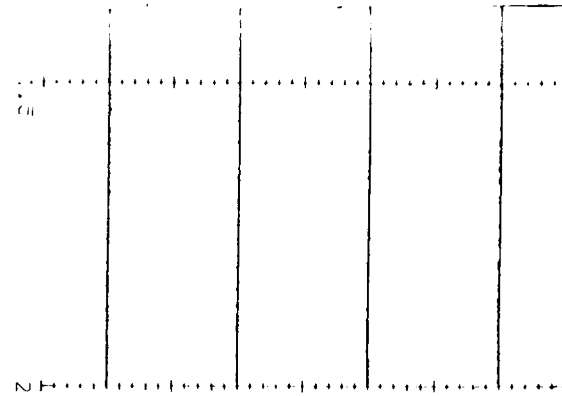
MEASUREMENTS

	V	T	R
PPV (in/s)	.03	.05	.05
TIME (ms)	112	115	115
FREQ (Hz)	512	32	34
PPA (g)	.29	1.65	2.95

PVS (in/s) .08 (112 ms)
PSPL (psi) .000024

SERIAL#:U5-I079008
CALIBRATED BY:
THOMAS INSTRUMENTS, SPOFFORD, NH USA
FEBRUARY 12,1990





SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 2 second(s)

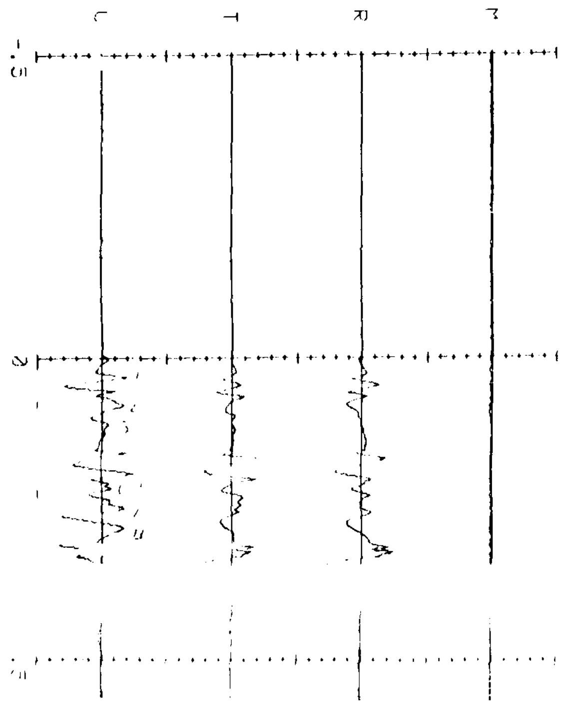
TRIGGERED at 12:53:49 12-11-1990

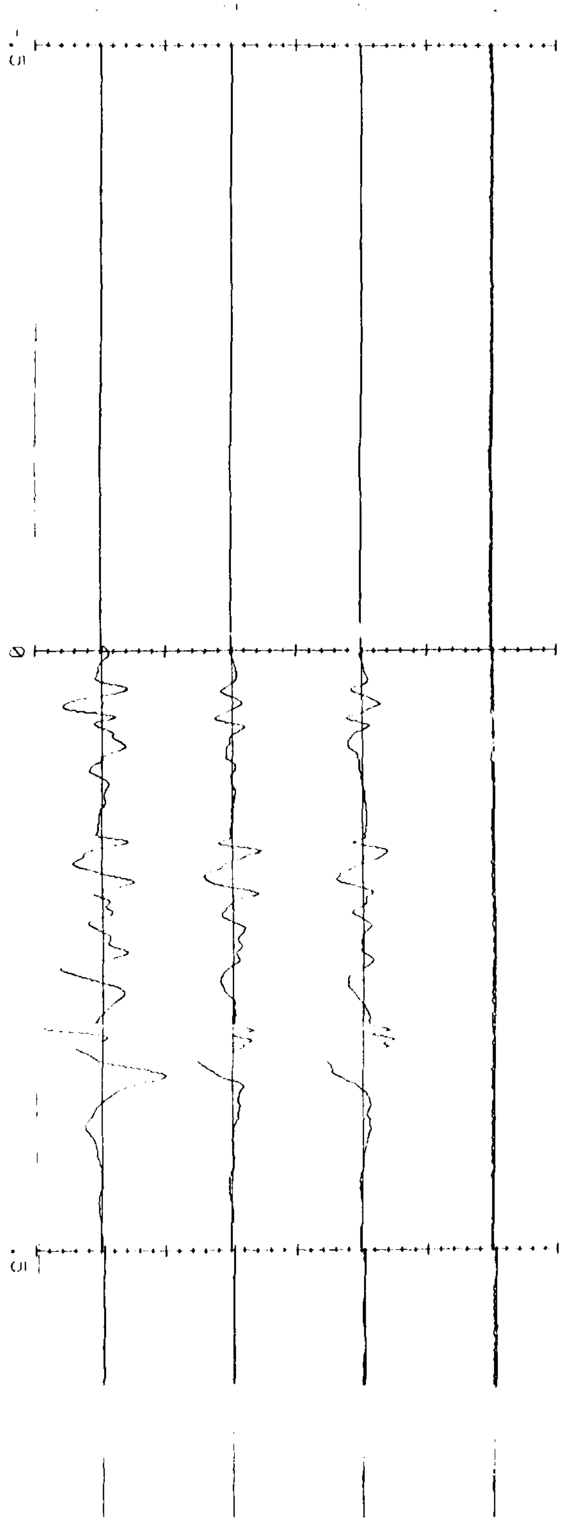
MEASUREMENTS

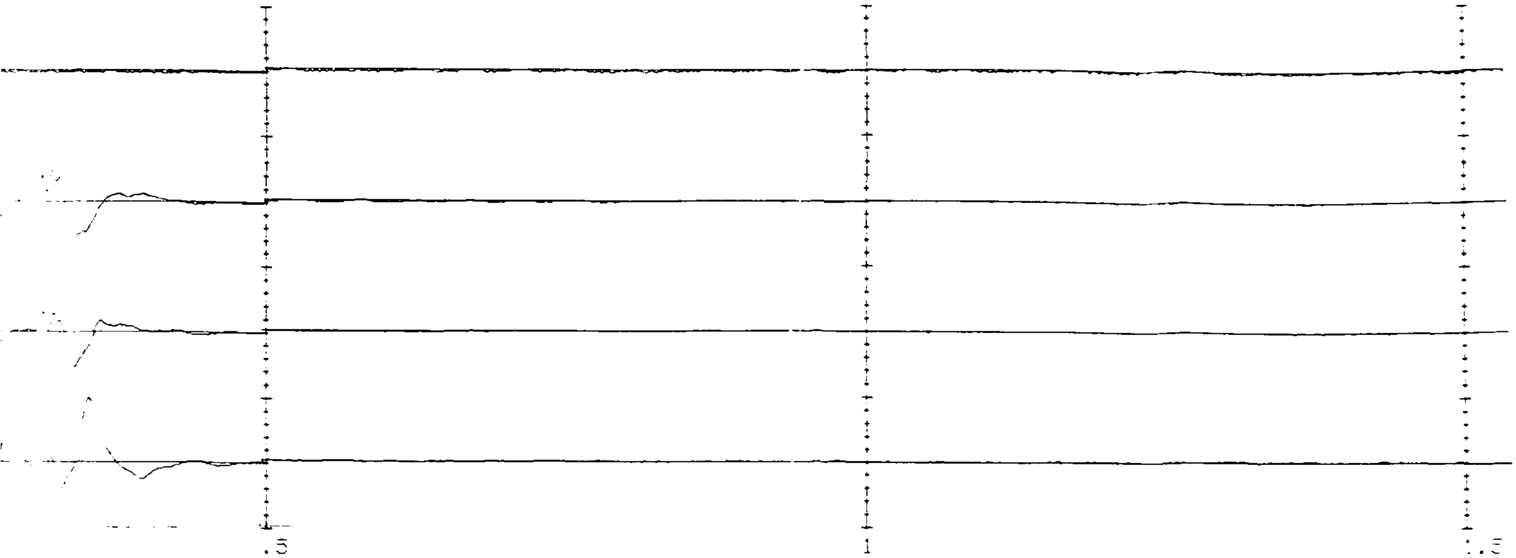
	V	T 54%	R 52%
PPV (in/s)	1.55	.85	.87
TIME (ms)	351	343	343
FREQ (Hz)	15	20	16
PPA (g)	2.72	2.52	1.01

PVS (in/s) 1.72 (354 ms)
PSPL (psi) .000082 (89 db)

SERIAL#:VS-L069020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990






.5
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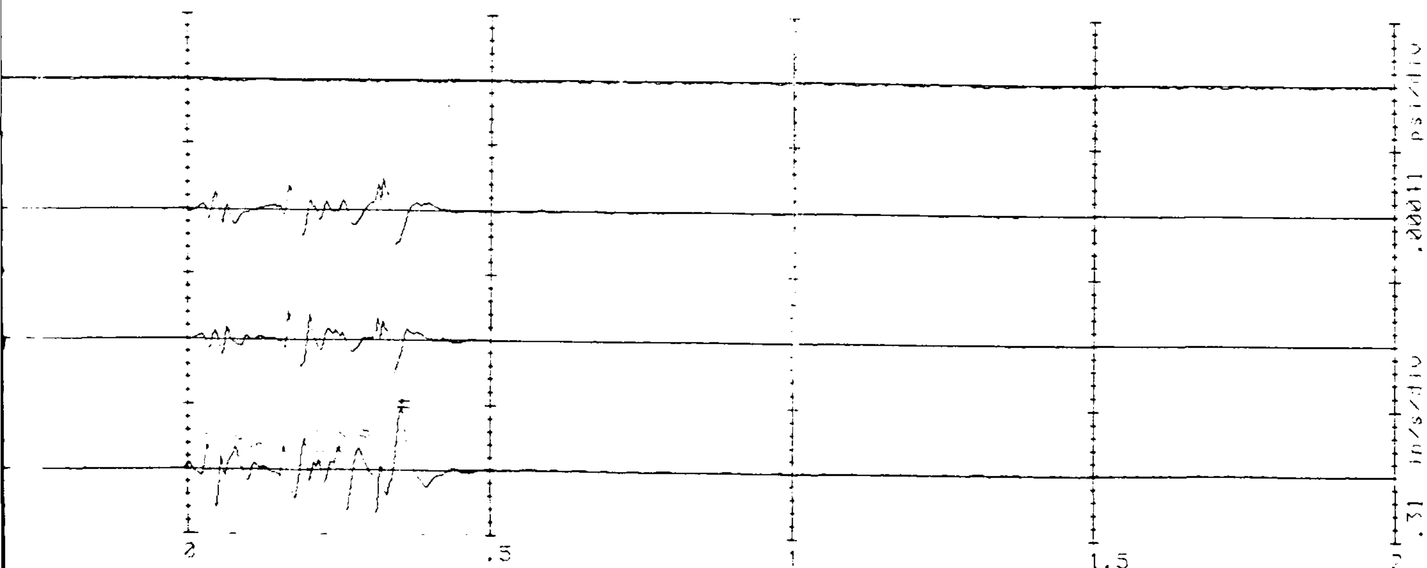
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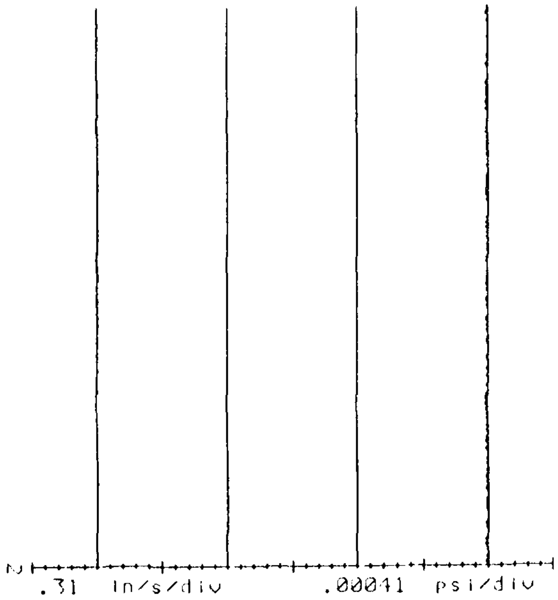
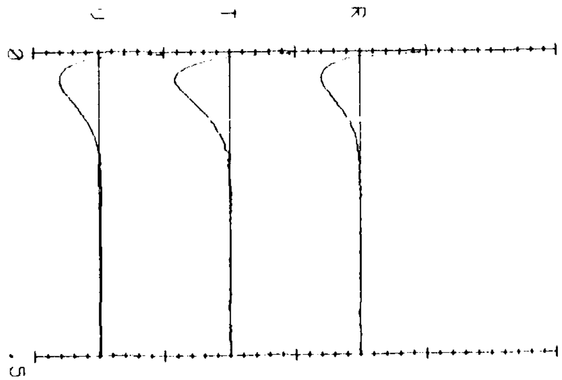
1.5

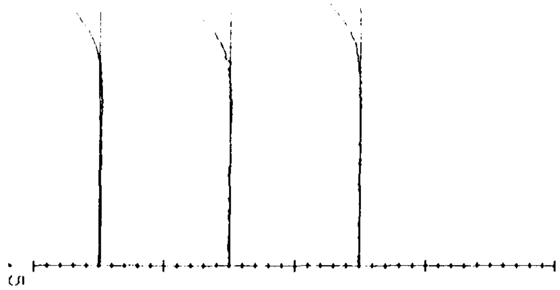


SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION



SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HLOW
DISTANCE FROM SENSOR TO BLAST
  8
NOTES
  BLAST C-32-8

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  GELMAX11/2X16 200G 2X16 GELMAX
TOTAL WEIGHT OF EXPLOSIVES USED
  90.4
NUMBER OF CAPS
  9
NUMBER OF DELAYS
  9
MAX WEIGHT/DELAY
  10
AVERAGE DEPTH OF HOLE
  25
NUMBER OF HOLES
  12
SPACING & BURDEN
  24IN PRE-SPLIT 5X5 PRODUCTION
TYPE OF BLAST
  PRE-SPLIT PRODUCTION
WEATHER
  SUNNY/CLEAR
MATS,OVERBURDEN,SAND BLANKET
  MATS

12-13-90 • K.J. PAGE 1 of 2

ATT - MR. T. O'DONNELL

SEISMOGRAPH RESULTS - BLAST # C37-9

* MACHINE @ LOW LEVEL OUTLET WORKS DID NOT TRIGGER

* HIGH LEVEL OUTLET WORKS

- PEAK PARTICLE VELOCITY - VERTICAL = 8.13 IN/SEC.
- " " - TRANSVERSE = 1.84 IN/SEC
- " " - RADIAL = 2.13 IN/SEC

- PEAK VECTOR SUM = 8.41 IN. PER SEC.

ENERGY RATIO - VERTICAL = 0.0304
" " - TRANSVERSE = 0.0010
" " - RADIAL = 0.0008

EXAMINATION OF THE PRINTOUT INDICATES THAT THE HIGH READING OCCURRED ON PERIOD #14 - WHICH WAS THE FIRST SET OF FIVE PRE-SPLIT HOLES (=10.2 LBS/DELAY), ADJACENT TO THE CONCRETE STRUCTURE (DRAIN) AT A SCALED DISTANCE FACTOR OF 2.51.

IN AN EFFORT TO REDUCE THE VIBRATION WE PROPOSE THE FOLLOWING:

1) DRILL PRODUCTION HOLES ON A 4'x4' PATTERN & CONTINUE THE PRE-SPLIT HOLES AT 2.0' C/C.

2) REDUCE THE LBS PER DELAY BY 50% BY "DECKING" THE COLUMN LOAD I.E. TWO DELAY PERIODS PER HOLE

3) MAX PRE-SPLIT HOLES PER DELAY TO BE REDUCED TO THREE

4) BLASTING OF THE PRODUCTION HOLES TO COMMENCE AT THE FREE FACE AND WORK BACK INTO THE BODY OF THE SHOT

5. THE FIRST PRODUCTION BLAST SHALL BE THREE HOLES (SIX DELAYS) WITH A MAXIMUM LBS PER DELAY OF 5.0 LBS.

6. THE NUMBER OF PRODUCTION HOLES PER [illegible]

12-13-90 • K.S. PAGE 2 of 2

7) PRE-SPLIT holes SHALL be shot only after the production holes have been shot and the material excavated to create a "Free Face"

8) Initially the pre-split holes shall be decked at 2 decks per hole

Additional steps may have to be taken if the above methods are not successful in reducing the peak particle velocities.

Those many include any of the following:

a) Reduced Bench Height
b) Smaller Ø bore holes & smaller Ø Dynamite
c) Tighter patterns
d) Decking
e) Sequential Blasting
f) Greater Delayment

Generally the most significant factor contributing to peak particle velocity is the lbs/per delay. All of the steps listed above are aimed at reducing the lbs/delay to achieve acceptable peak particle velocities.

C.C.
Contracting Officer

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 2 seconds

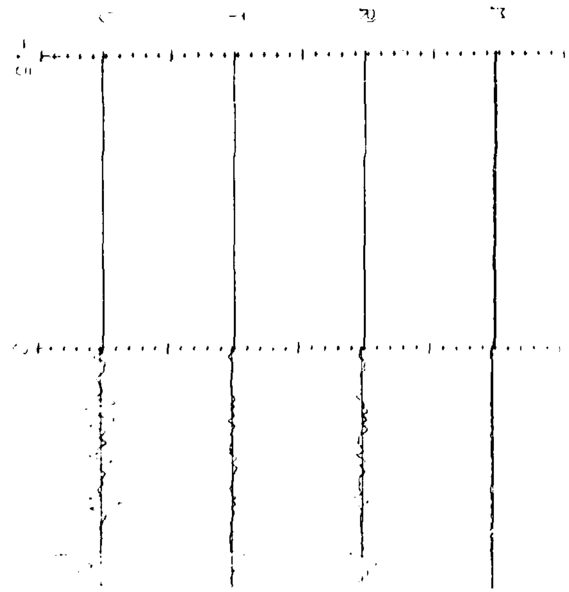
TRIGGERED at 11:05:31 12-13-1988

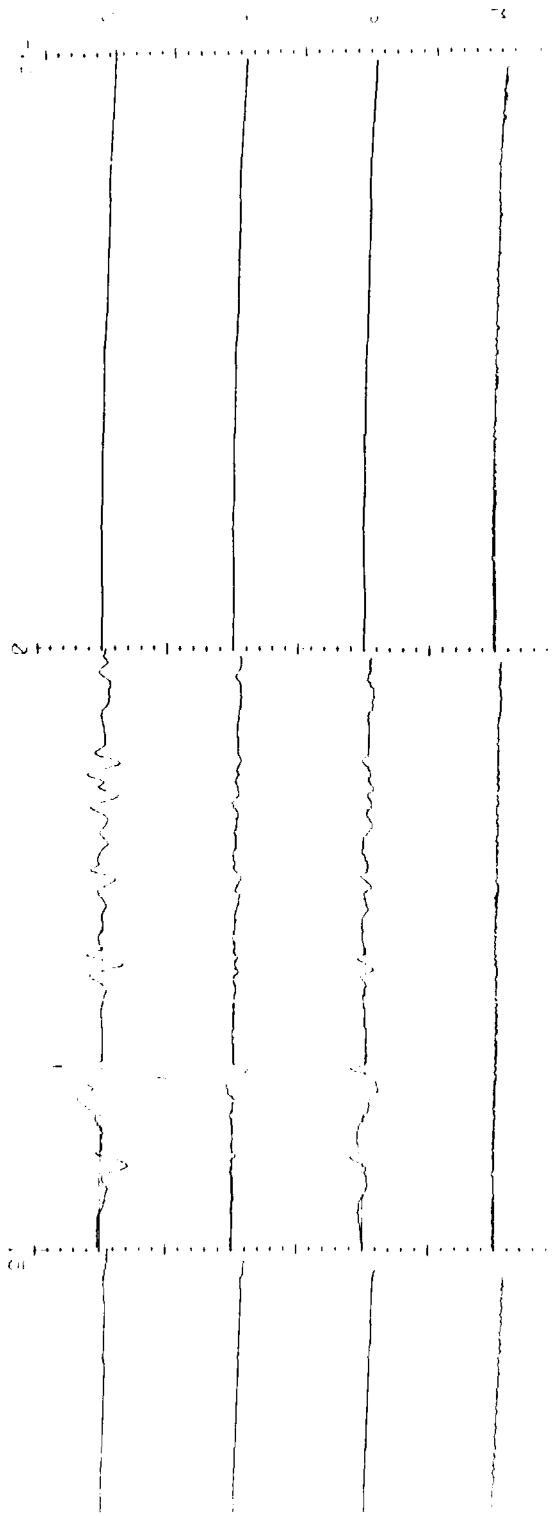
MEASUREMENTS

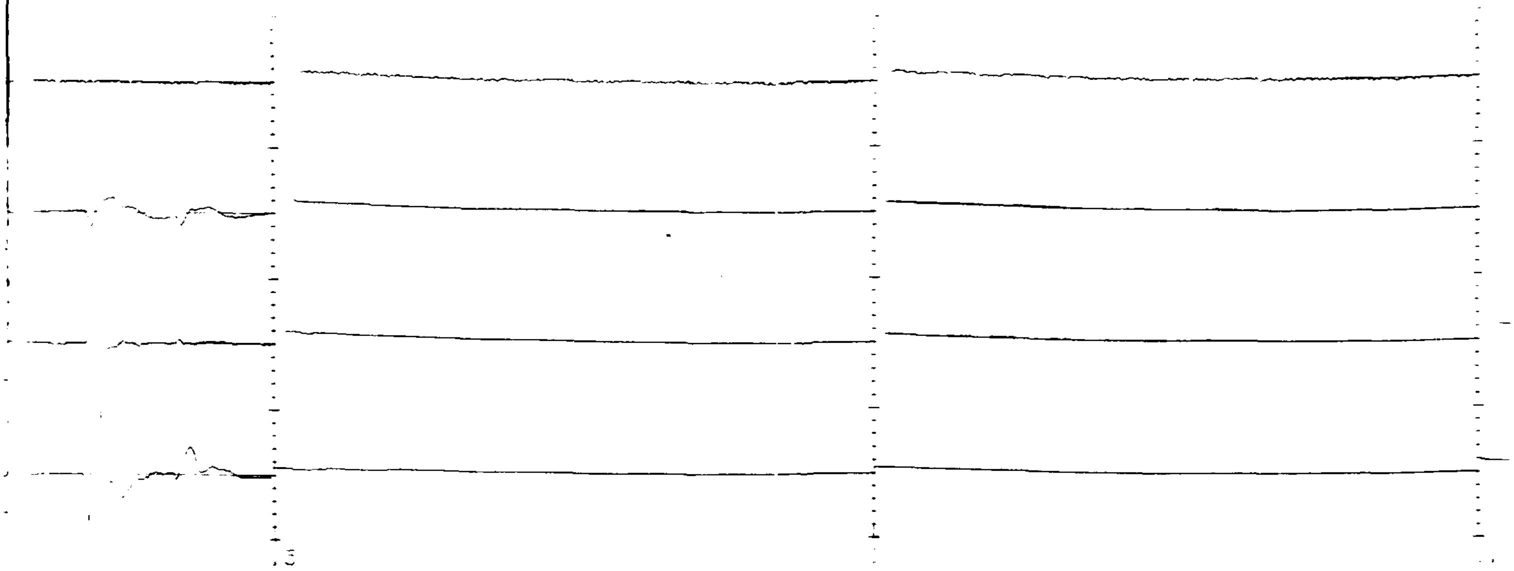
	V	T	R
PPV (in/s)	8.13	1.84	2.13
TIME (ms)	352	350	349
FREQ (Hz)	42	57	64
PPA (g)	.87	.24	1.72

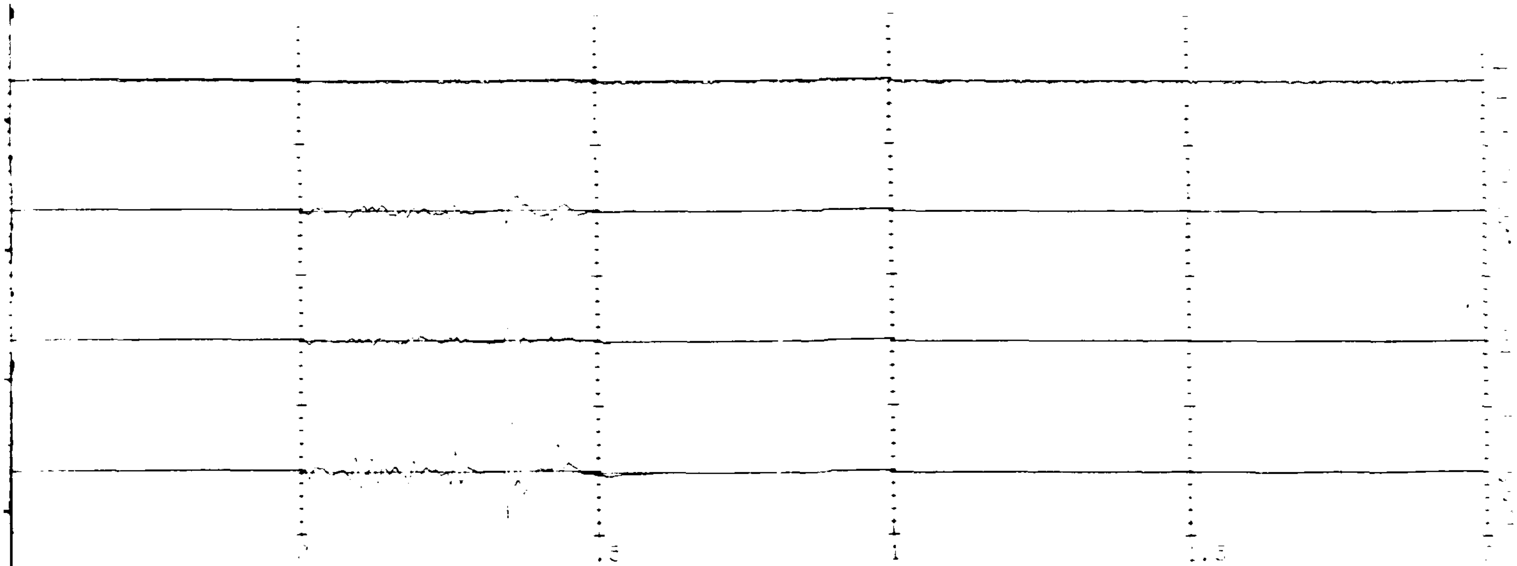
PVS (in/s) 8.41 (352 ms)
PSPL (psi) .000082 (83 db)

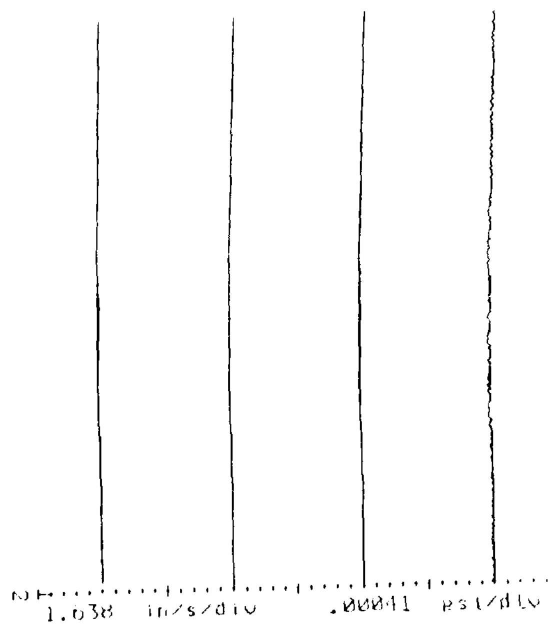
SERIAL#:05-1060026
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1988



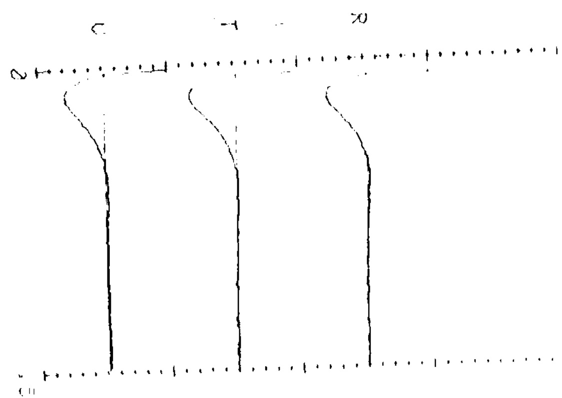






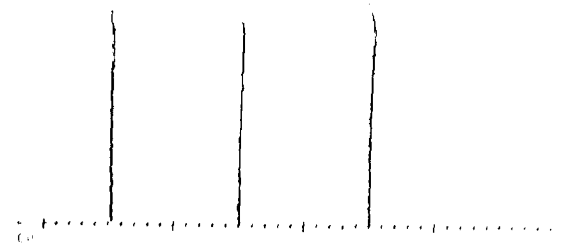


SENSOR TEST



SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCI
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION



SEISMOGRAPH LOG

PROJECT
CHEATHAM DAM
CLIENT
PCI
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
BELOW
DISTANCE FROM SENSOR TO BLAST
8
NOTES
BLAST C-32-9

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
GELMAXII/2X16 200G 2X16 GELMAX
TOTAL WEIGHT OF EXPLOSIVES USED
35.4
NUMBER OF CAPS
12
NUMBER OF DELAYS
12
MAX WEIGHT/DELAY
10.21
AVERAGE DEPTH OF HOLE
[illegible]
NUMBER OF HOLES
[illegible]
SPACING & BURDEN
2 1IN PRE-SPLIT 5X5 PRODUCTION
TYPE OF BLAST
PRE-SPLIT PRODUCTION
WEATHER
CLOUDY RAIN
HOLES,OVERBURDEN,SAND [illegible]
[illegible]

CUCHILLO DAM PROJECT
BLAST #C37-16
3 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 32 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.58 in/sec.

ENERGY RATIO - VERTICAL = 0.00027
ENERGY RATIO - TRANSVERSE = 0.00156
ENERGY RATIO - RADIAL = 0.00763

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 1 second(s)

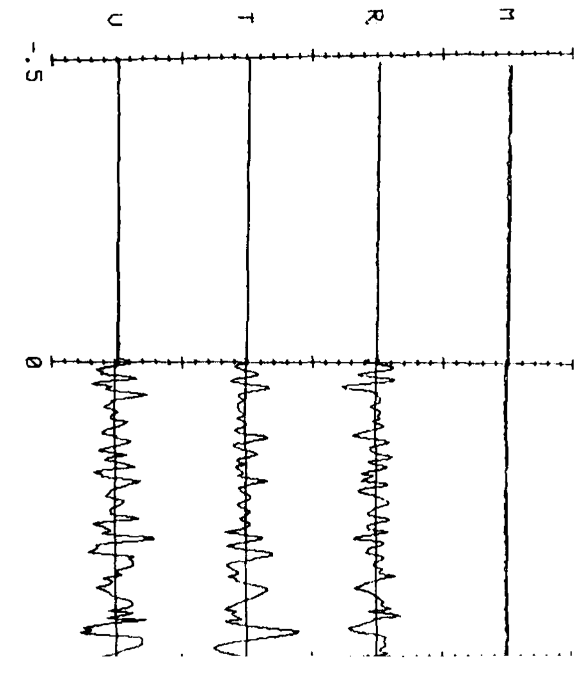
TRIGGERED at 14:07:46 01-03-1991

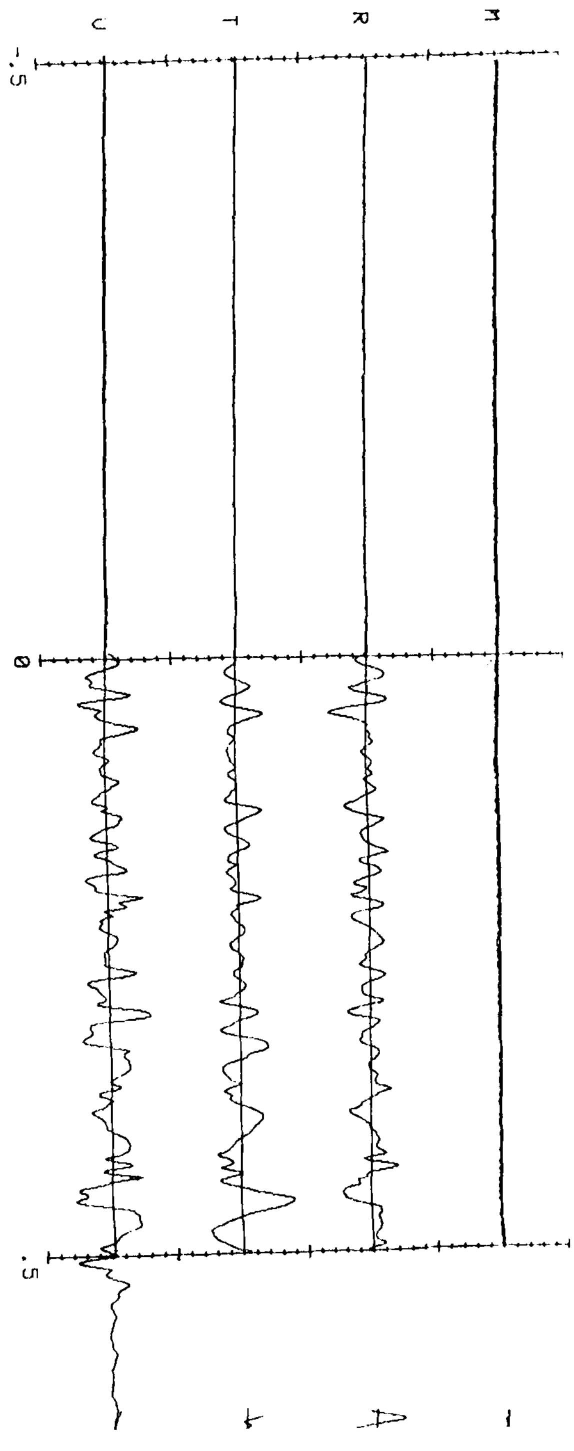
MEASUREMENTS

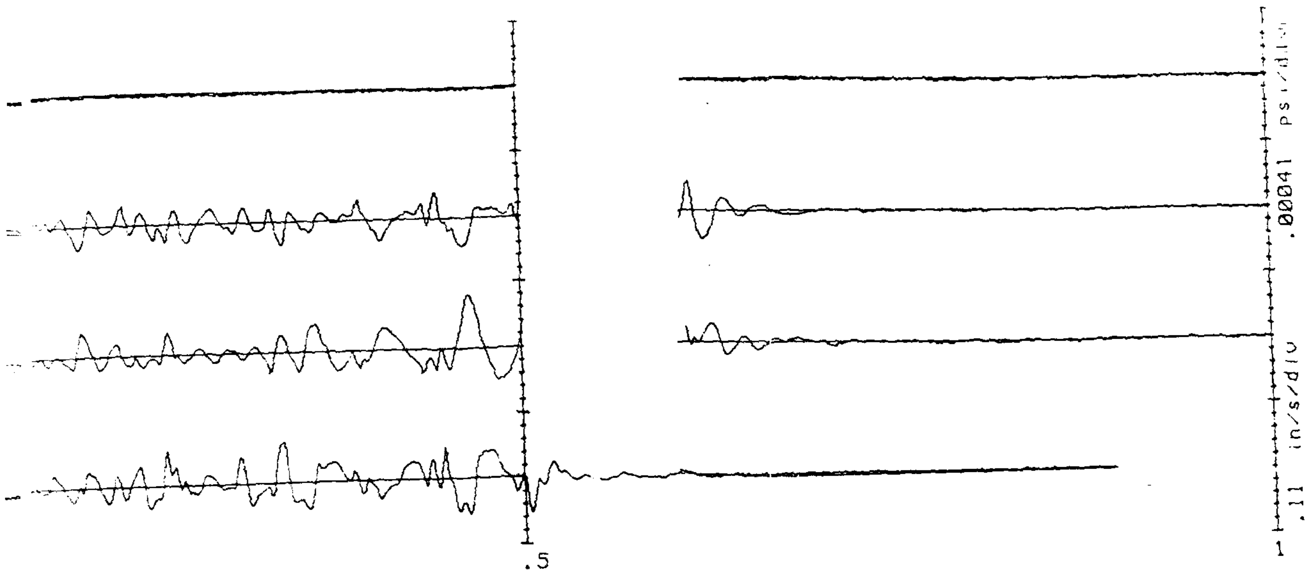
	V	T	R
PPV (in/s)	.34	.44	.32
TIME (ms)	300	454	49
FREQ (Hz)	43	20	34
PPA (g)	.7	.79	2.97

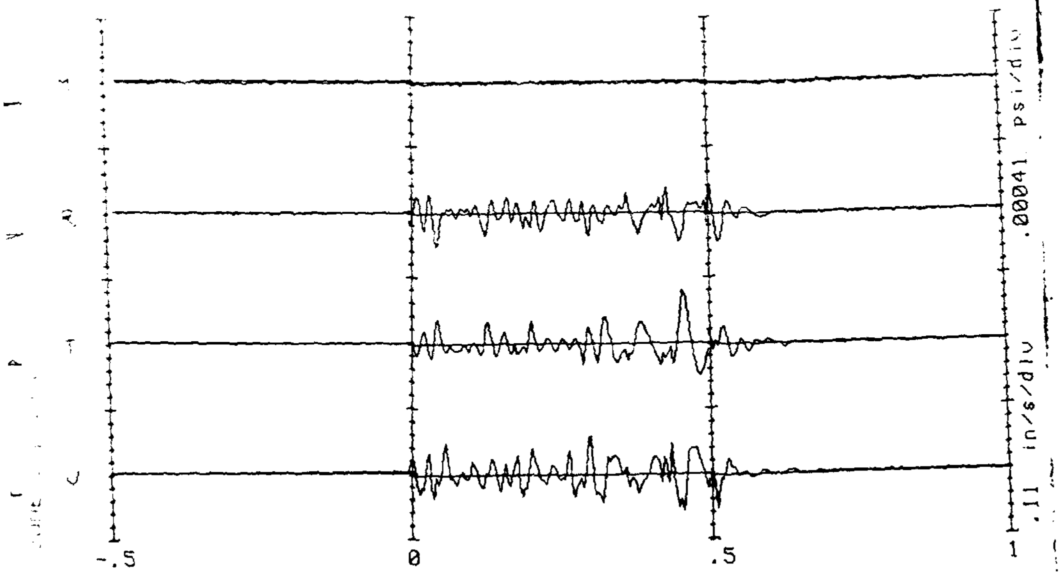
PVS (in/s) .58 (453 ms)
PSPL (psi) .000082 (89 db)

SERIAL#:V5-L069020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990

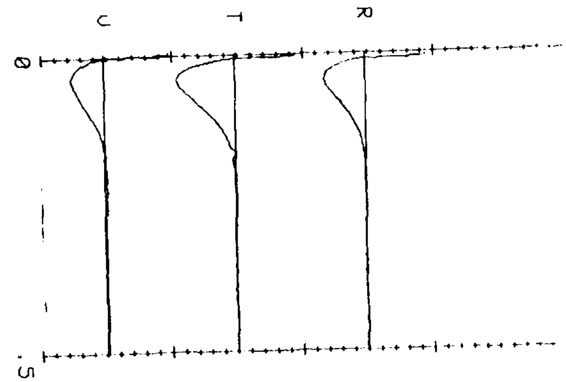





.5
1
.00041 psi/div
.11 in/s/div


-.5
0
.5
1
.00041 psi/div
.11 in/s/div

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HLOW
DISTANCE FROM SENSOR TO BLAST
  32
NOTES
  BLAST C-37-16

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
  50
NUMBER OF CAPS
  40
NUMBER OF DELAYS
  20
MAX WEIGHT/DELAY
  5
AVERAGE DEPTH OF HOLE
  3.5
NUMBER OF HOLES
  40
SPACING & BURDEN
  3.5X3.5

SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HLOW
DISTANCE FROM SENSOR TO BLAST
  32
NOTES
  BLAST C-37-16

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
  50
NUMBER OF CAPS
  40
NUMBER OF DELAYS
  20
MAX WEIGHT/DELAY
  5
AVERAGE DEPTH OF HOLE
  3.5
NUMBER OF HOLES
  40
SPACING & BURDEN
  3.5X3.5
TYPE OF BLAST
  PROD
WEATHER
  SUNNY
MATS,OVERBURDEN,SAND BLANKET
  MATS

CUCHILLO DAM PROJECT
BLAST #C37-20
11 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 32 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.49 in/sec.

ENERGY RATIO - VERTICAL = 0.00038
ENERGY RATIO - TRANSVERSE = 0.00044
ENERGY RATIO - RADIAL = 0.00081

SET-UP INFORMATION

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 1 second(s)

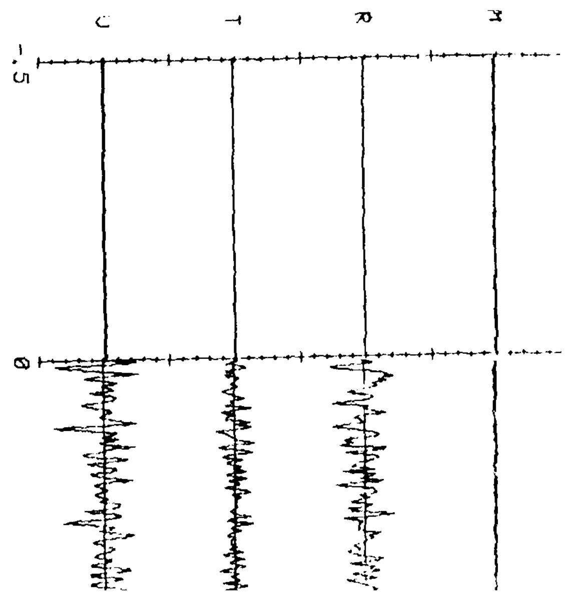
TRIGGERED at 16:35:33 01-11-1991

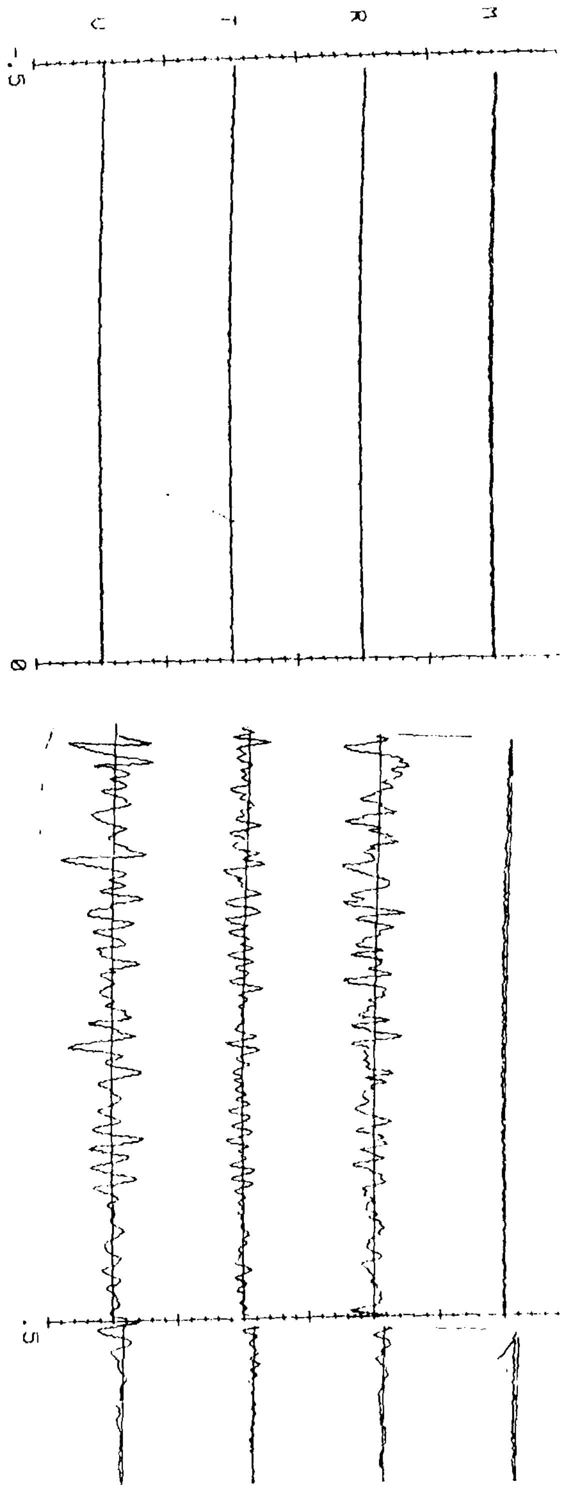
MEASUREMENTS

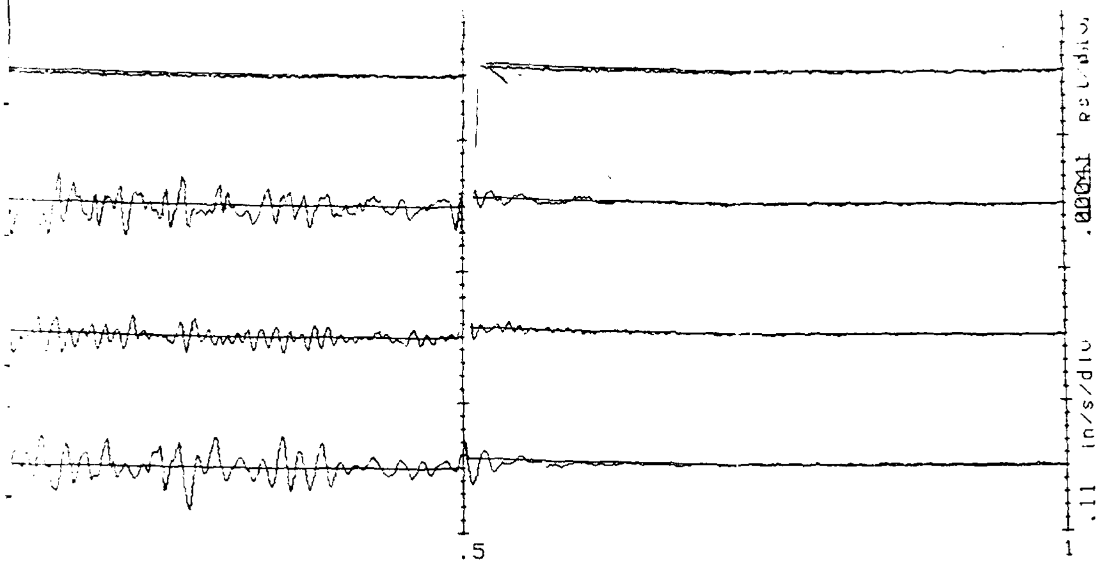
	V	T	R
PPV (in/s)	.46	.2	.3
TIME (ms)	116	14	14
FREQ (Hz)	47	85	42
PPA (g)	.92	1.78	1.34

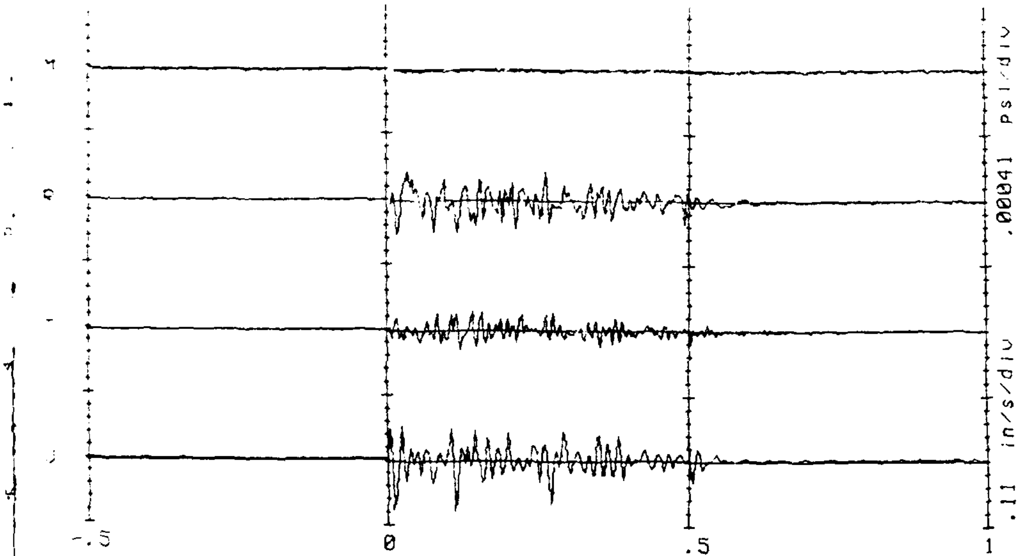
PVS (in/s) .49 (116 ms)
PSPL (psi) .000082 (89 db)

SERIAL#:V5-L069020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990

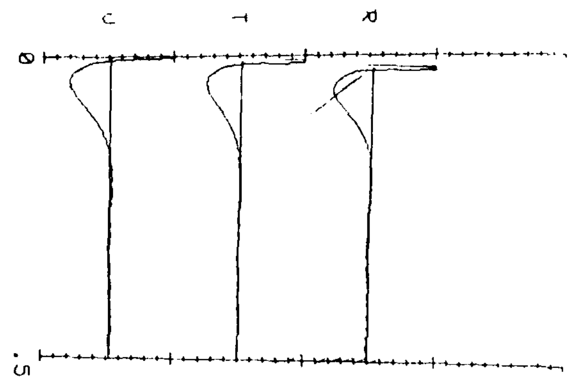





.5
1
.00041 psi/div
.11 in/s/div


-.5
0
.5
1
.00041 psi/div
.11 in/s/div

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HLOW
DISTANCE FROM SENSOR TO BLAST
  BLAST C-37-20
NOTES
  BLAST C-37-19

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
  65
NUMBER OF CAPS
  60
NUMBER OF DELAYS
  20
MAX WEIGHT/DELAY
  2.5
AVERAGE DEPTH OF HOLE
  4
NUMBER OF HOLES
  60
SPACING & BURDEN
  3.5X3.5
TYPE OF BLAST
  PROD

SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HLOW
DISTANCE FROM SENSOR TO BLAST
  BLAST C-37-20
NOTES
  BLAST C-37-19

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
  65
NUMBER OF CAPS
  60
NUMBER OF DELAYS
  20
MAX WEIGHT/DELAY
  2.5
AVERAGE DEPTH OF HOLE
  4
NUMBER OF HOLES
  60
SPACING & BURDEN
  3.5X3.5
TYPE OF BLAST
  PROD
      & PRESPLIT
WEATHER
  SUNNY
MATS,OVERBURDEN,SAND BLANKET
  MATS

CUCHILLO DAM PROJECT
BLAST #C37-21
12 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 32 FEET FROM BLAST.

TRIGGER LEVEL WAS NOT EXCEEDED DURING MONITORING INTERVAL.

THOMAS INSTRUMENTS
SPOFFORD, NEW HAMPSHIRE USA
TELEPHONE: 603-363-4500

SET-UP INFORMATION

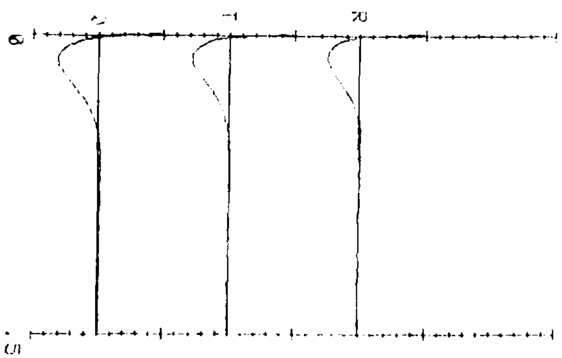
MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 1 second(s)

START TIME: 10:57:01 01-12-1991
FINISH TIME: 09:55:59 11-29-1990

** TRIGGER LEVEL WAS NOT EXCEEDED **
** DURING MONITORING INTERVAL **

SERIAL#:U5-L069020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990

SENSOR TEST

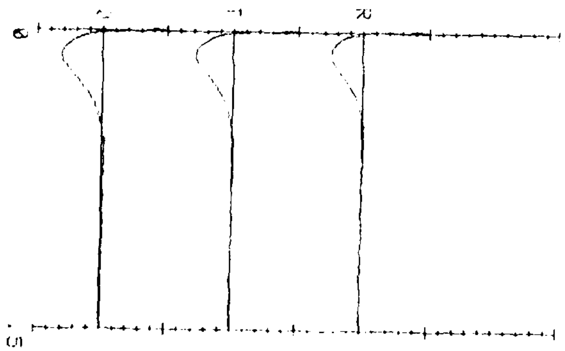


SEISMOGRAPH LOG

PROJECT
COCHITI DAM
CLIENT
OPERATOR
KEVIN STEVENSON

SENSOR SERIES L065020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
COCHITI DAM
CLIENT
COE
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
ROAD
DISTANCE FROM SENSOR TO BLAST
32
NOTES
BLAST C-32-21

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
2X16GN
TOTAL WEIGHT OF EXPLOSIVES USED
40
NUMBER OF CAPS
40
NUMBER OF DELAYS
20
MAX WEIGHT/DELAY
2
AVERAGE DEPTH OF HOLE
4
NUMBER OF HOLES
40
SPACING & BURDEN
X 5X5
TYPE OF BLAST
PROD
* RES > 1:
WEATHER
SUNNY
MATS
HAY/RUBBER TIRE/SAND BLANKET

CUCHILLO DAM PROJECT
BLAST #C37-22
14 JANUARY 1991
BLAST SEISMOGRAPH MONITOR REPORT

1. HIGH LEVEL OUTLET WORKS 120 FEET FROM BLAST.

PVS - PEAK VECTOR SUM (VIBRATION) = 0.09 in/sec.

ENERGY RATIO - VERTICAL = 0.00424
ENERGY RATIO - TRANSVERSE = 0.00059
ENERGY RATIO - RADIAL = 0.00092

MODE: Single Event
SOURCE: Geophone
GEO TRIGGER LEVEL: .02 in/s
RECORD TIME: 1 second(s)

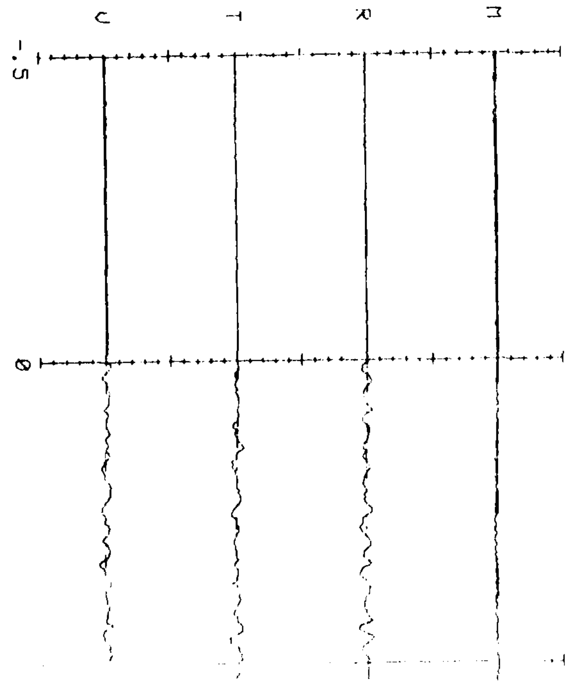
TRIGGERED at 16:37:57 01-14-1991

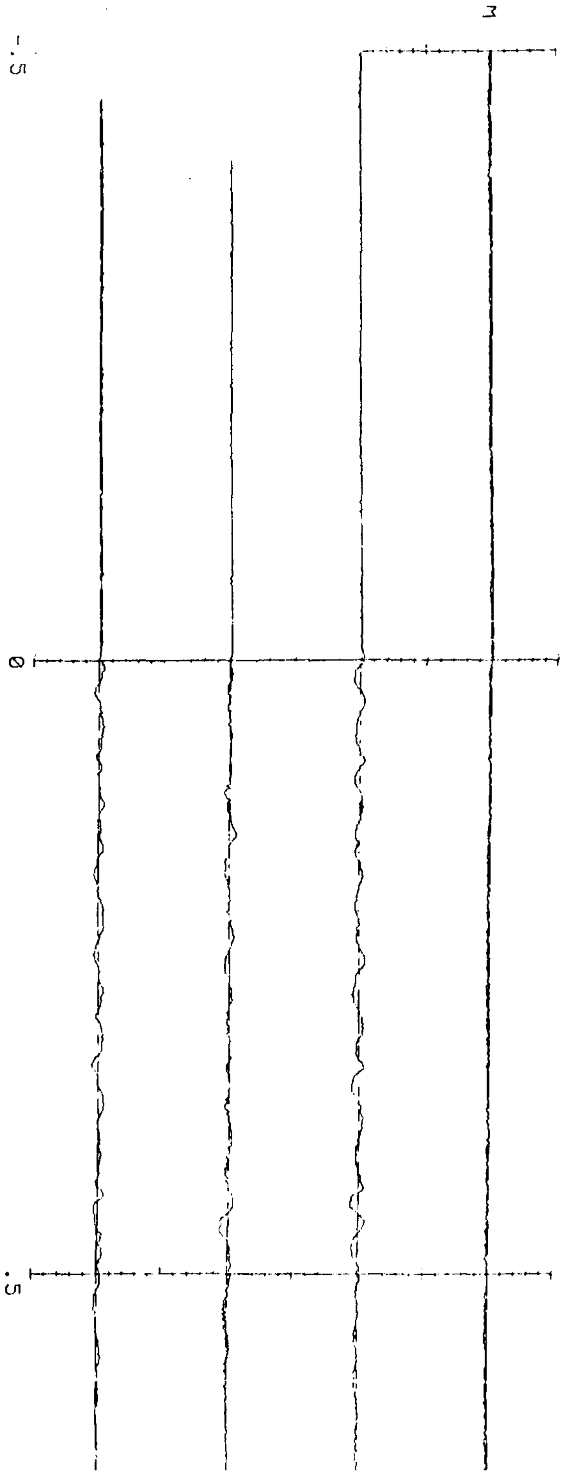
MEASUREMENTS

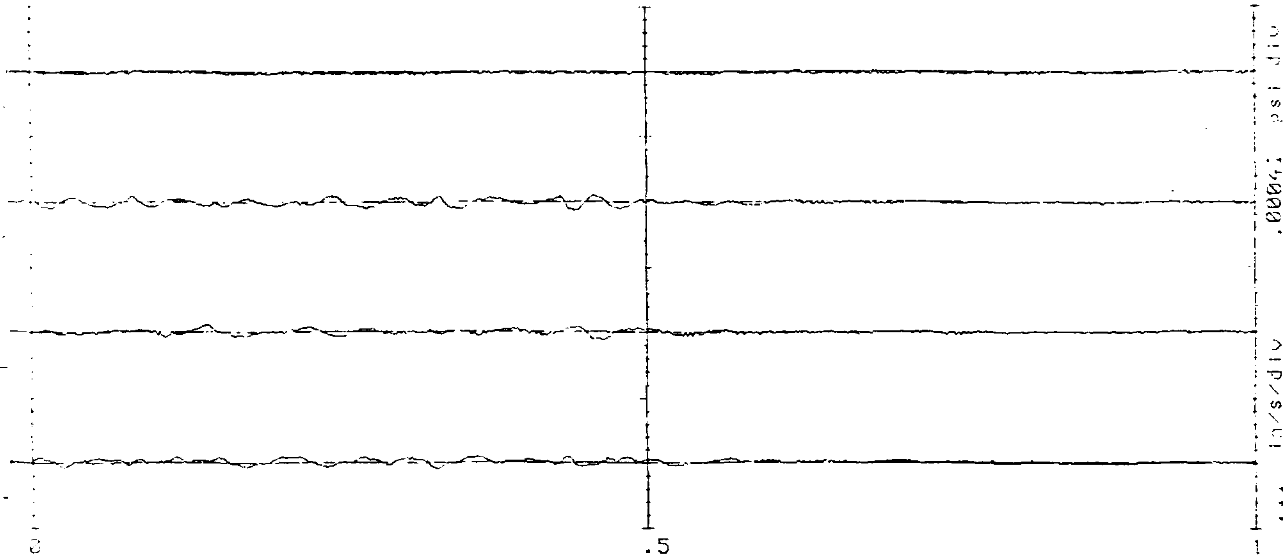
	V	T	R
PPV (in/s)	.05	.07	.07
TIME (ms)	329	464	442
FREQ (Hz)	32	23	30
PPA (g)	2.41	.56	.91

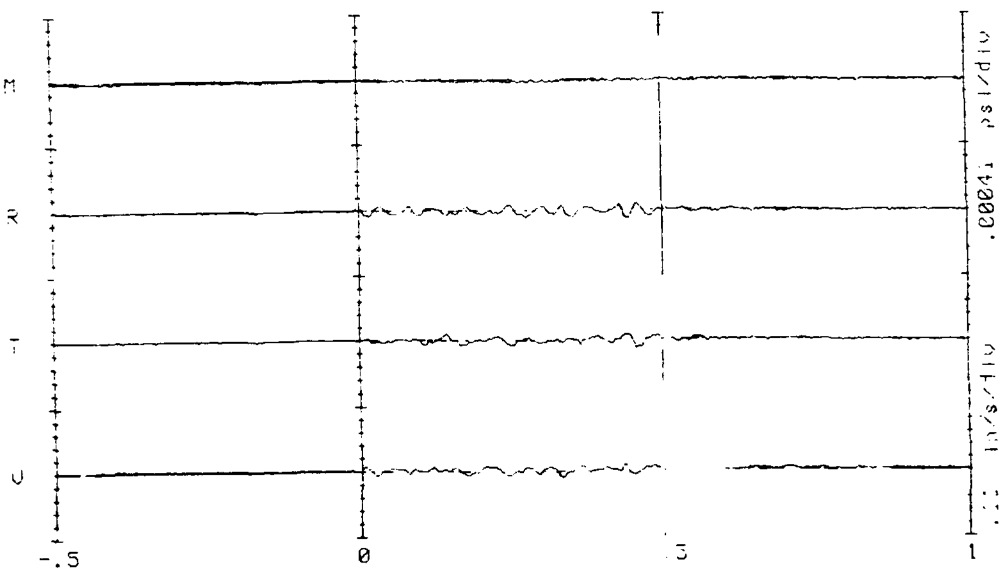
PUS (in/s) .09 (457 ms)
PSPL (psi) .000002 (89 db)

SERIAL #:V5-L069020
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990



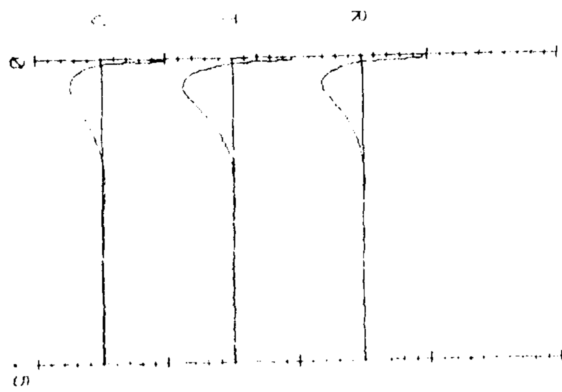






SERIAL #[illegible]
CALIBRATED BY:
THOMAS INSTRUMENTS INC.
JUNE 15, 1990

SENSOR TEST



SEISMOGRAPH LOG

PROJECT
  CUCHILLO DAM
CLIENT
  PCL
OPERATOR
  KEVIN STEVENSON
SEISMOGRAPH LOCATION
  HLOW
DISTANCE FROM SENSOR TO BLAST
  120
NOTES
  BLAST C-32-22

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
  2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
  40
NUMBER OF CAPS
  20
NUMBER OF DELAYS
  30
MAX WEIGHT/DELAY
  2.5
AVERAGE DEPTH OF HOLE
  4
NUMBER OF HOLES
  30
SPACING & BURDEN
  1.5X3.5
TYPE OF BLAST
  FREE

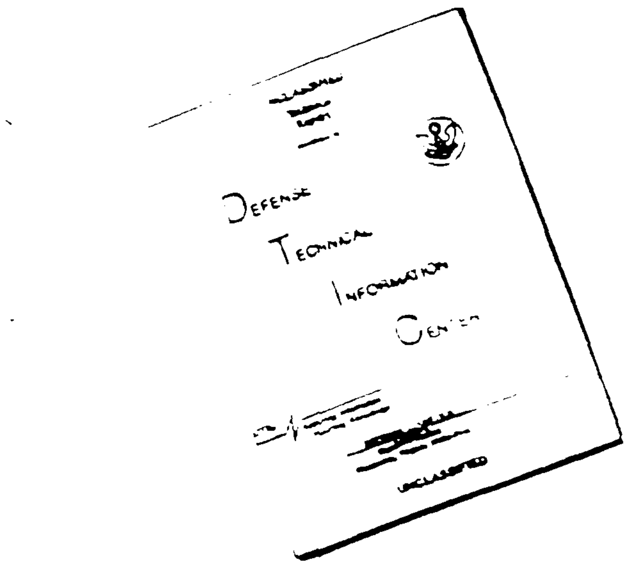
SEISMOGRAPH LOG

PROJECT
CUCHILLO DAM
CLIENT
PCL
OPERATOR
KEVIN STEVENSON
SEISMOGRAPH LOCATION
HLOW
DISTANCE FROM SENSOR TO BLAST
120
NOTES
BLAST C-32-22

BLASTING LOG

EXPLOSIVES SPECIFICATIONS
2X16GM
TOTAL WEIGHT OF EXPLOSIVES USED
40
NUMBER OF CAPS
70
NUMBER OF DELAYS
30
MAX WEIGHT/DELAY
2.5
AVERAGE DEPTH OF HOLE
4
NUMBER OF HOLES
30
SPACING & BURDEN
3.5X3.5
TYPE OF BLAST
PROD
& PRESPLIT
WEATHER
SUNNY
MATS,OVERBURDEN,SAND BLANKET
MATS

DISCLAIMER NOTICE



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